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THE

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PASSENGER AND GUARD COMMUNICATION.

IT is understood that the Departmental Committee appointed by the Board of Trade to consider (1) whether the means of communication between passengers in railway trains and the servants of the company in charge of the trains are efficient; (2) whether any particular system of communication in use, or available, is so efficient as to make its general adoption by the railway companies desirable; and (3) whether any extension or amendment of the law on the subject is desirable, have rendered a report to the effect:—

That (1) of the methods of communication at present adopted the outside cord system should be condemned as inefficient, while the systems in which the cord or wire is inside the carriages cannot be regarded as satisfactory. The principal electric systems, and the communication by means of the brake may, however, be held to be efficient; (2) that no one of the electrical systems so far excels the others as to enable the Committee to recommend it for general adoption, although they prefer the system of communication which has been experimentally used by the Great Eastern Railway Company; (3) that the law should be extended so as to require the provision on all trains of an efficient means of communication between passengers and the servants in charge of the trains, which should also be used as a means of communication between the guards and the driver.

The Committee also append certain conditions which, in their opinion, it is desirable any such communication should fulfil. These are: (*a*) It should lend itself readily to the interchange of carriages between different railways; (*b*) it should be easily applicable, and should communicate directly with the driver as well as with the guards, whilst the means by which it is actuated by the passenger should be in a conspicuous position either in the centre or at both ends of the compartment, without affording too great a temptation to passengers to tamper with it; (*c*) it should be reasonably cheap in initial cost and maintenance; (*d*) it should afford an indication outside the carriage, and a passenger should not be able to replace the means by which the alarm is given; (*e*) it should not entail the use of additional couplings to those already existing, viz., the screw coupling, the side chains, the automatic brake, and the heating apparatus (where in use); and (*f*) it should be capable of being used as a means of communication between the driver and the guards of a train as well as between the passenger and the driver and guards.

We welcome the report. Its conclusions are doubtless precisely what anyone who has cared to consider the subject would have anticipated. The recommendations as to the conditions to which such a communication should conform are entirely those which any practical mind would look for. That eventually electricity would be the agent employed we have felt no doubt, and that the provision of the means of communication was as necessary in

trains which stopped at every station on the way, as well as those which ran 20 miles without stopping, was abundantly and lamentably proved by the outrage which occurred on the London and South-Western line between Barnes and Wandsworth not long since. We are glad to notice that this has been recognised, and, further, that legislation on the question is to be sought. Railways have of recent years been called upon for large outlays in order to comply with the requirements of the Board of Trade. The provision of an efficient passenger and guard communication will not be so costly a matter as the establishment of the block, or the automatic brake; but it is well that railway directors should, in its inauguration, feel that they have the law behind them. We are quite in accord with the recommendation that, if possible, one of the present means of coupling should be made use of for that under consideration. We hardly see how this can be accomplished otherwise than as has been done by the Great Eastern Company's electrical engineer, and even here we fear departmental difficulties will arise; the brake gear is not under the electrical engineer, nor will the electrical gear be under the rolling stock superintendent. There is, however, no reason why the two communications should not be combined, and we doubt not that, seeing it has been done on the Great Eastern Railway, it will be accomplished on other lines. It is most desirable the means of coupling should be universal, and that the electrical system should be the same, or such as will admit of common use.

We welcome the conclusions arrived at. Thirty years have passed since the first electrical passenger and guard communication was established, only to be followed on the great majority of our lines by the "cord" system. Has it taken 30 years to prove its inutility? We think not! Its unsuitability has been more than once rendered patent, and that for many years. It was in 1868 that an Act of Parliament was passed calling upon the railway interest to establish by April 1st, 1869, a means of communication in all trains travelling over 20 miles without stopping. In the following February (1869) the Board of Trade permitted the adoption, conditionally, of the system which has been in operation ever since. In 1872 Sir Henry Tyler, then the chief inspecting officer of the Department, denounced it as unsatisfactory in its operation. It has, however, remained in use, and, probably, would still have continued to do so, had not the foul outrage previously referred to again called attention to the subject. We are bound to admit that the difficulty of establishing something more reliable and more ready to hand has not been so much a want of interest on the part of the railway companies, as the provision of that which would be really of service in cases of outrage. And it must be admitted that this part of the question has not yet been disposed of. The means for raising an alarm must be within the reach of a passenger almost at every point of a carriage—one point, or two points, from which it may be operated is practically, except as a deterrent, useless. The ruffian would take care his victim did not reach it. The question has at last been disposed of by the Board of Trade. It will now, no doubt, go into the hands of the railway officials. Such points as we have referred to will not be new to them, and we make no doubt that when the time comes for them to deal with them they will do so n a thorough manner.

Metallic Sulphide Electrodes.—In electrolysis with electrodes of metallic sulphides, the following changes occur: (1) In acid solutions, at the anode the metal is dissolved and the sulphur precipitated or oxidised; at the cathode, hydrogen sulphide is formed with separation of the metal. (2) In alkaline solutions, at the anode the metal forms a hydroxide, and the sulphur is oxidised; at the cathode the metal is precipitated, and the sulphur passes into solution as an ion. Lead sulphide was first employed for quantitative work, and it was observed that the resistance of this compound decreases with rise of temperature, although the conduction is purely metallic. In alkaline solutions the quantity of lead precipitated and of sulphur dissolved at the cathode was found to be in complete accord with Faraday's law. The electrodes are best prepared electrolytically from pure lead, and by means of such electrodes a constant E.M.F. may be obtained in sodium sulphide solutions, if alteration in the latter is prevented by passing a continuous current of hydrogen sulphides. Measurements of the E.M.F. of lead sulphide in solution of sodium sulphide at different concentrations, indicated the univalency of the ions, which the author hence considers to be $-SH$. The current passes from the more highly to the less concentrated solutions, and the changes occurring at the electrodes may be thus represented: $PbS + SH_2 \rightleftarrows Pb + 2SH^-$, in the more dilute solution, therefore, two SH ions are formed, and one undissociated SH_2 disappears, whilst the reverse obtains in the more concentrated solution. The E.M.F. is hence given by the equation $\pi = RT/\epsilon + \log. c_1/c - RT/2\epsilon + \log. c'_1/c'$, where c_1, c are the concentrations of the ions, and the c'_1, c' are the concentrations of the undissociated hydrogen sulphide. When the concentration of the hydrogen sulphide was kept constant, that is, $\log. c'_1/c' = 0$, the E.M.F. was found to agree well with the calculated value. Further, by the use of equally concentrated sodium-hydrc-sulphide solutions saturated with hydrogen sulphide at different pressures, an E.M.F. was obtained which agreed satisfactorily with the value calculated from the expression $\pi = -RT/2\epsilon + \log. c'_1/c_1$. By the use of electrodes of silver sulphide and of bismuth sulphide, similar results were obtained, so that, as the expression shows, the electromotive force is independent of the valency of the metal. By the use of cells of the type: silver | N/1 silver nitrate | N/1 sodium hydro-sulphide | silver sulphide, the solubility of the silver sulphide, &c., may be found; the values thus obtained for the silver, lead, and bismuth sulphides are respectively $3{\cdot}4 + 10^{-22}$, $2{\cdot}9 + 10^{-5}$, and $2{\cdot}1 + 10^{-28}$. The above is an abstract of a paper by Isidor Bernfeld in the *Zeitschrift für Physikalische Chemie*, Vol. xxv., pages 46—73.

Motor Gears.—The gearing of two motors by three bevel wheels (see Report of Physical Society on another page) is an exceedingly useful adaptation of an old mechanical movement. This three-bevel wheel gear has many valuable properties, for it can be applied with a sliding clutch for reversing the rotation of a shaft, and is so used on lathes; it can be used for multiplying the speed of rotation, and as a differential gear, it has been applied in Dr. Aron's electricity clock meter; it can also be employed on motor cars to enable one motor to drive two wheels at different speeds. The beauty of the gear applied to two electro-motors lies in the ease with which the motors may have their speeds varied or reversed. We should think it will be of great value in applying motors to many purposes besides steering gear for ships. The only drawback the gear has is that it is noisy at high speeds; but this could be overcome if the intermediate wheel can be made of raw hide leather. The gear might be found useful on cranes and machine tools driven by electro-motors, where a wide range of differential speeds are necessary. For belt driving, the intermediate bevels may be carried on the belt pulley, but for wheel and pinion drives it will be necessary to have a hollow shaft in one of the motors, through which the shaft carrying the intermediate wheel can pass to carry the pinion.

METALLIC RESISTANCES.

By KILBURN SCOTT, A.I.E.E.

Resistances have always been a necessity, but with the increase that has taken place in motor work the necessity for well designed starting and regulating, besides other, resistances, has become more pronounced. The following particulars may possibly be of use to those who have to get out, or work with, these necessary, but somewhat troublesome, adjuncts of electrical work.

Table I. has been compiled from many sources, and may be safely taken to give the average values—ohms per yard and ohms per pound—these being the values the writer has found most useful for the four materials or alloys, German silver, platinoid, iron, and manganin.

It should be noticed that the columns of weights—yards per pound and pounds per yard—are made common to all the materials. As a matter of fact this is not strictly correct, as the weight per cubic inch varies slightly, but for ordering in material it is near enough, the actual amount used being governed by the resistance test after the spirals are wound.

The particulars for iron wire are for the best charcoal iron galvanised. In the larger diameters it is advisable to galvanise the spirals after they are wound, as the spelter sometimes flakes off in the coiling.

The Whitecross Company, Limited, of Warrington, say that in drawing wire which is intended to be galvanised they draw it rather smaller in diameter to allow for the zinc coating, so that when completed there is no appreciable difference in resistance and weight over bright or non-galvanised iron wire.

In the column giving approximate watts per yard for a rise of 50° C. the figures are taken as common to all the four materials. The reasoning for this is due to the fact that whilst the current required to produce a given waste in watts per yard is proportional to the square root of the specific resistance, yet owing to the differences in resistance the expenditure of energy remains about the same. Thus copper wire will take, say, 3½ times as much current as iron wire of the same diameter to raise it to a given temperature, but owing to the difference in the two resistances the actual expenditure of energy will be about the same in each case.

The columns headed "Normal current in iron frame" may be taken as approximately representing the safe current which the wire will take continuously when wound as a vertical spiral in the ordinary way with plenty of ventilation. As motor starting resistances have only to take the full current momentarily, the figures in the second column under "Amperes carried" should be taken. Thus for speed regulating purposes No. 16 B.W.G. iron wire taking 7½ amperes continuously would be employed, but if it were for starting purposes only, 15 amperes might be reckoned on. It often happens that a resistance is built up partly for starting and partly for regulating, in which case it often pays to properly distinguish between the two and use platinoid with a low temperature coefficient for the regulating whilst the starting coils are made of iron wire.

The diameters of mandrils suitable for the various sizes of wires which are given in the table are taken from actual practice. The usual method is to wind the wire as a close coil and then pull it out to about double the length, so that the spaces are about equal to the diameter of the wire. The smaller sizes of wire really require pulling out rather more than double the

Table I.—Giving Resistance, Weight, Current Carrying Capacity, Size of Mandril, &c., of Various Alloys suitable for Resistance Frames.

B.W.G.	Diameter in inches.	Diameter in millimetres.	Area in square inches.	Approximate weights. Yards per lb. per yrd. at 31 lb. per cub. inch.	Approximate weights. Lbs. per yrd.	Approximate watts dissipated per yard for a rise of 50° C. with normal current.	Diameter of mandril on which wire is coiled.	Length of spiral of 100 turns close-coiled.	Length of spiral of 100 turns equally spaced.	Length of wire in coil 100 turns close-coiled.	German silver. Resistance at 15° C.—59° F. Ohms per yard.	German silver. Resistance at 15° C.—59° F. Ohms per lb.	German silver. Resistance at 15° C.—59° F. Ohms per 100 turns on mandril.	German silver. Amperes carried. Normal current in iron frame.	German silver. Amperes carried. For one minute.	Platinoid. Resistance at 15° C.—59° F. Ohms per yard.	Platinoid. Resistance at 15° C.—59° F. Ohms per lb.	Platinoid. Resistance at 15° C.—59° F. Ohms per 100 turns on mandril.	Platinoid. Amperes carried. Normal current in iron frame.	Platinoid. Amperes carried. For one minute.	Iron (galvanised). Resistance at 15° C.—59° F. Ohms per yard.	Iron (galvanised). Resistance at 15° C.—59° F. Ohms per lb.	Iron (galvanised). Resistance at 15° C.—59° F. Ohms per 100 turns on mandril.	Iron (galvanised). Amperes carried. Normal current in iron frame.	Iron (galvanised). Amperes carried. For one minute.	Manganin. Resistance at 15° C.—59° F. Ohms per yard.	Manganin. Resistance at 15° C.—59° F. Ohms per lb.	Manganin. Resistance at 15° C.—59° F. Ohms per 100 turns on mandril.	Manganin. Amperes carried. Normal current in iron frame.	Manganin. Amperes carried. For one minute.
26	·018	·457	·000254	340	·003	1/8	·375	18	36	3·37	1·39	441·81	4·35	·5	1·0	1·92	650	6·5	·5	1·0	·644	218·1	2·16	·75	1·5	2·30	780	7·75	·5	1·0
25	·020	·508	·000315	275	·0035	1/8	·375	20	40	3·42	1·12	289·87	3·59	·75	1·5	1·54	420	5·25	·6	1·2	·520	142·5	1·77	1·0	2·0	1·85	510	6·33	·6	1·2
24	·022	·559	·000380	228	·004	1/8	·375	22	44	3·46	·871	197·99	3·00	1·0	2·0	1·27	290	4·41	·7	1·4	·431	92·6	1·49	1·5	3·0	1·53	396	5·3	·7	1·4
23	·025	·635	·000491	176	·005	1/8	·375	25	50	3·48	·675	118·73	2·34	1·25	2·5	·987	213	3·43	·8	1·6	·335	55·5	1·16	1·75	3·5	1·2	290	4·1	·8	1·6
22	·028	·711	·000616	140	·007	1/8	·375	28	56	3·50	·539	75·46	1·88	1·5	3·0	·785	110·35	2·74	·95	1·9	·266	35·3	·93	2·0	4·0	·934	151	3·3	1·0	2·0
21	·032	·813	·000804	108	·009	1/8	·375	32	64	3·55	·410	44·23	1·46	1·75	3·5	·603	67·3	2·54	1·25	2·5	·204	20·68	·725	2·5	5·0	·715	88	2·5	1·25	2·5
20	·035	·889	·000962	90	·0108	1/8	·375	35	70	4·66	·345	31·06	1·61	2·25	4·5	·475	40·4	2·22	1·5	3·0	·123	14·45	·575	3·5	7·0	·434	62	2·0	1·5	3·0
19	·042	1·067	·001385	62	·0148	1/8	·375	42	84	4·74	·241	14·90	1·14	2·5	5·0	·350	27·8	1·66	1·75	3·5	·118	6·97	·581	4·5	9·0	·415	30	1·96	1·75	3·5
18	·049	1·245	·001886	46	·021	2/8	·5	49	98	4·77	·175	8·04	·835	3·0	6·0	·267	12·8	1·27	2·25	4·5	·087	3·76	·415	5·75	11·5	·304	16·1	1·45	2·25	4·5
17	·058	1·473	·002642	33	·031	2/8	·5	58	116	4·87	·124	4·10	·604	4·0	8·0	·187	6·9	·91	2·75	5·5	·062	1·92	·302	7·5	15·0	·304	8·2	1·05	2·75	5·5
16	·065	1·65	·003318	26	·037	2/8	·5	65	130	6·02	·100	2·60	·602	5·0	10·0	·150	4·04	·90	3·5	7·0	·048	1·215	·290	9·5	19·0	·166	5·2	1·02	3·5	7·0
15	·072	1·83	·004071	21	·042	2/8	·625	72	144	6·09	·082	1·72	·500	5·5	11·0	·119	3·3	·73	4·0	8·0	·041	·806	·250	8·0	16·0	·146	3·45	·88	4·0	8·0
14	·083	2·11	·005411	16	·058	3/8	·625	83	166	6·20	·061	·98	·378	7·0	14·0	·096	1·65	·59	4·75	9·5	·035	·457	·217	10·0	20·0	·109	1·95	·675	4·75	9·5
13	·095	2·41	·007088	12	·082	3/8	·75	95	190	7·36	·052	·628	·382	8·5	17·0	·068	1·00	·50	6·0	12·0	·025	·32	·184	12·5	25·0	·084	1·00	·622	6·0	12·0
12	·109	2·77	·009331	10	·098	4/8	·75	109	218	7·50	·038	·366	·290	11·0	22·0	·057	·58	·43	7·75	15·5	·018	·197	·135	16	32·0	·063	·63	·474	7·75	15·5
11	·120	3·05	·011309	7·5	·130	4/8	·75	120	240	7·60	·033	·230	·226	12·5	23·0	·043	·36	·33	9·0	18·0	·014	·118	·106	18·5	37·0	·048	·36	·37	9·0	18·0
10	·134	3·40	·014103	6·75	·149	5/8	·875	134	268	8·79	·025	·167	·216	14	28·0	·037	·25	·30	10·0	20·0	·011	·086	·097	21	42·0	·040	·27	·35	10·0	20·0
9	·148	3·76	·017203	5·0	·200	5/8	·875	148	296	8·92	·022	·112	·200	15	30·0	·028	·18	·25	11·0	22·0	·010	·067	·089	23	46·0	·036	·18	·395	11·0	22·0
8	·165	4·19	·021382	4·3	·232	6/8	1·0	165	330	10·11	·017	·068	·172	19	38·0	·024	·10	·243	13·5	27·0	·008	·035	·080	28	56·0	·028	·12	·28	13·5	27·0
7	·180	4·57	·025447	3·4	·295	7/8	1·0	180	360	10·30	·014	·046	·140	23	46·0	·019	·07	·196	16	32·0	·006	·023	·065	33	66·0	·022	·075	·228	16	32·0
6	·203	5·16	·032365	2·6	·379	7/8	1·25	203	406	12·70	·011	·029	·142	27	54·0	·015	·046	·190	19	38·0	·0052	·015	·066	40	80·0	·018	·047	·23	19	38·0
5	·220	5·59	·038013	2·25	·440	8/8	1·25	220	440	12·81	·009	·020	·115	30	60·0	·013	·032	·166	21	42·0	·0047	·010	·060	44	88·0	·014	·031	·167	21	42·0

Table II.—Particulars of Resistance, Current Capacity, &c., of Hadfield's "Resista."

Gauge.	Diameter.		Ohms at 15·5° C.	50° C. rise in temperature.			100° C. rise in temperature.			150° C. rise in temperature.			200° C. rise in temperature.		
B.W.G.	Inches.	mm.		Ohms per yard at 65·5° C.	Amperes giving a rise of 50° C.	Watts consumed per yard.	Ohms per yard at 115·5° C.	Amperes giving a rise of 100° C.	Watts consumed per yard.	Ohms per yard at 165·5° C.	Amperes giving a rise of 150° C.	Watts consumed per yard.	Ohms per yard at 215·5° C.	Amperes giving a rise of 200° C.	Watts consumed per yard.
8	·16	4 064	·0541	·0571	20·1	23·1	·0601	33·0	65 5	·0631	33	96	·0661	53	186
9	·144	3 658	·0669	·0706	17·8	22 4	·0743	28·1	58 6	·0780	34	90	·0817	43	151
10	·128	3 251	·0845	·0890	15·1	20 3	·0938	22 8	48 75	·0984	27·8	76·00	·103	35·6	131
11	·116	2 946	·1024	·1080	13 2	18 8	·1137	19 6	43 70	·119	23 7	66 7	·125	30 5	116
12	·104	2 642	·1290	·136	11·3	17 4	·143	16 6	39 35	·150	20 2	61 2	·157	26 0	106
13	092	2 336	·1646	·174	9 4	15 4	·183	13·7	34·35	·192	16 6	52 8	201	21 7	95
14	08	2·032	·2150	230	7 6	13 3	·242	11 6	32·55	·254	13 9	49 0	·266	18 0	86
15	·072	1 829	·2·70	·282	6·7	12 7	·295	10 0	29·60	311	12·1	45 5	326	16 0	83
16	·064	1 626	3382	·357	5 7	11·6	377	8 60	27 90	3 4	10·5	43 4	413	13 4	74
17	056	1 422	·4406	·465	4·7	10 3	489	7 20	25 4	513	8 8	39 7	·547	11 3	70
18	048	1 219	·6 03	634	4·0	10 15	·667	5 93	23 5	·7(0	7·35	37 8	733	9 27	63
19	04	1 016	·8677	915	3·2	9 38	963	4 80	22 2	1 01	5·91	35 3	1 06	7 45	59
20	·036	914	1 068	1·13	2 84	9·12	1·19	4 25	21 5	1·24	5 25	34·2	1 30	6 66	58
21	·032	813	1·3528	1·43	2·5	8 94	1·50	3 75	21·1	1 59	4 61	33 8	1 65	5 80	56
22	·028	·711	1 7666	1·86	2·15	8·60	1 96	3·30	21·4	2 06	4·03	33 5	2·16	5·07	55·5
23	·024	·610	2 4030	2 54	1·83	8·50	2·67	2·80	20 9	2 80	3 44	33 2	2 93	4 33	55 0
24	022	·559	2 8658	3 02	1·62	7·93	3·18	2 53	20 4	3·34	3 12	32 5	3 50	3·96	54 8
25	·02	·508	3·4665	3 66	1 49	8·13	3 85	2·29	20 2	4·04	2 82	32 2	4 23	3·57	54 0
26	·018	·457	4 2764	4·51	1 32	7·86	4 75	2·05	20·0	4 98	2 52	31 6	5 22	3·19	53 2
27	0164	·417	5 1531	5·44	1·2	7 83	5·72	1·84	19 4	6 00	2 29	31·4	6 29	2 90	52 8
28	·0148	·376	6 3279	6·68	1·07	7·65	7·02	1·65	19·1	7 37	2 05	31·0	7·73	2 59	52 3
29	·0136	·340	7·4938	7 91	·98	7 59	8 32	1·51	19 0	8·73	1 87	30 4	9·14	2 36	50 8
30	·0124	·315	9·01125	9·51	·895	7 61	10 00	1 36	18·5	10 50	1·69	29 9	11·00	2 15	50 8

length because they lack stiffness. No. 24 B.W.G. is generally the smallest size used in practice. Whilst at the other end of the table it is very seldom a wire larger than No. 8 B.W.G. is employed, because of the difficulties in coiling.

Manganin gives the lowest temperature coefficient, but it is run very close by London Electric Company's alloy "Eureka."

Particulars of Mr. Hadfield's "Resista" are given in Table II. It is a manganese steel alloy having a specific resistance of 75·5 microhms per cubic centimetre. It is readily coiled into spirals, can be soldered, and if desired is supplied with a dust proof coating.

(*To be continued.*)

THE WATERLOO AND CITY RAILWAY.

In the presence of a large number of invited guests this most interesting line was formally opened on Monday last by the Duke of Cambridge. The function consisted merely of a trip to the City and back, followed by a luncheon. There was no opportunity of inspecting the system in detail, and our readers must be perforce content with the following meagre description, which has been furnished by the company. It is a matter of extreme regret that the consulting engineers of the line have not seen fit to grant facilities to the technical press for fully illustrating and describing the system, for we are convinced that not only would the Waterloo line itself have been materially benefited, but electric traction, and more than all, English contractors would have been greatly aided by such publicity.

The object of the Waterloo and City Railway is to afford the London and South-Western Company access from their terminus at Waterloo to the heart of the City. The necessity of such a connection was recognised by the directors of the company more than half a century ago, and from time to time schemes have been projected with the intention of providing such a railway. All involved an enormous outlay, ranging from £3,000,000 to at least £5,000,000. The directors were unwilling to purchase a City approach at this price, but when they found that the purpose could be achieved by means of an electrical railway deep underground at a cost of about £500,000, they at once decided to carry out the project. In South London the success of electrical haulage for train service had been clearly demonstrated, and Parliament readily gave its assent to the construction of a double line, carried in tunnels, from Waterloo to the Mansion House.

An independent company was created for the management of the railway, with Mr. Wyndham Portal, the chairman of the London and South-Western Company, at its head. Plans were prepared by Mr. W. R. Galbraith, the consulting engineer of the London and South-Western Company, and Mr. J. H. Greathead, the local supervision of the work being entrusted to Mr. H. H. Dalrymple-Hay. Mr. Greathead died during the progress of the work, and his place has since been filled by Prof. Kennedy, who made himself responsible for the whole of the electrical arrangements as they have been executed by Messrs. Siemens Bros. & Co.

The contract for the line itself was let to Messrs. Mowlem and Co., of Millbank, who commenced operations in June, 1894, by erecting a timber pile staging in the River Thames, a short distance above Blackfriars Bridge. Two shafts were sunk to the level of the railway, and these proved of immense advantage, in that they enabled the whole of the excavated material to be brought to the surface, and carried away to the Dagenham Marshes by barges, cartage through the public streets being thus entirely avoided. By the same shafts, iron, cement, bricks, and all else required in the making of the railway were introduced, and the construction of the two tunnels proceeded with steady regularity, the only delay which was experienced being attributable to the water-bearing strata through which, at several points, the tunnels had to be projected.

Leaving Waterloo by a somewhat sharp curve, the tunnels pass under York Road at a depth of only 18 feet from the surface, and thence descend towards the River, crossing Waterloo Bridge Road a few inches below the main sewer of the London County Council. Following the line of Stamford Street as far as Hatfield Street, they there turn towards the River, which they traverse in a north-easterly direction, emerging under the Victoria Embankment immediately in front of the Royal Hotel at Blackfriars. Curving into Queen Victoria Street, they continue under the centre of that thoroughfare at considerable depth, and terminate in a commodious station immediately opposite the Mansion House, the total length of the line being about one mile and a half.

The most difficult portions of the work had to be undertaken at the two termini. At Waterloo, the station of the Waterloo and City Railway is situated immediately underneath the main line platforms of the South-Western Company, the difference between the two levels being exactly 41 feet. There are three sloping ways of approach between the two stations, and two independent entrances from the outside thoroughfares. These five inclined ways lead to a common booking hall of extensive proportions, and there are three spacious avenues sloping towards each of the two platforms, which are 100 yards long and 14 feet wide. The arrival platform and a set of rails occupy one arch; the

departure platform and a second set of rails are laid under an adjoining arch, the two lines of rails being divided by a brick pier. The level at which the platforms are constructed is so deep that it was necessary to remove the foundations of the old piers upon which the South-Western station stands, and this work was accomplished without the slightest interruption to the enormous traffic conducted at the platforms of the South-Western Company.

A still more trying task had to be faced in order to provide a cross-over road by means of which the trains on the Waterloo and City Railway can be shunted from one set of rails to the other. The space acquired for the terminus did not permit of such a cross-over road being introduced without utilising a considerable portion of the area under the London and South Western station, and the engineers found it necessary bodily to remove one of the immense piers on which that station rests, and in its place to build a single arch of 40 feet span. This was an interesting and a bold piece of work, which attracted much attention among railway engineers. In the end it was most successfully accomplished, and the strength of the superstructure remains as great as ever.

At the City terminus, difficulties of another kind presented themselves. The crowded street-crossing which stands immediately in front of the Mansion House, the Bank of England, the Royal Exchange, Cheapside, and Queen Victoria Street, was honeycombed at no great distance from the level by pipes of every description—water, gas, pneumatic, compressed air, telegraph, telephone, electric lighting—and enormous sewers. The construction of the Waterloo and City terminus was only part of a great scheme of improvement which had to be undertaken at this point. It had been decided by the late Commissioners of Sewers to provide a subway connecting all the important points of the crossing, so that passengers might be able to go from the Bank or the Royal Exchange to the Mansion House, Queen Victoria Street, or Cheapside, as also between other points, without incurring the risk of using the open crossing. To this subway it was decided that passengers to and from the Waterloo and City Railway should have access, and a similar facility was also offered to those who will use the Central London Railway, which Parliament has also sanctioned.

Thus, three great schemes were simultaneously in progress below the street level at the Mansion House. The Waterloo and City Railway is the first to be completed, and although the subway has not yet reached the stage when it can be thrown open to the public, travellers by the Waterloo and City line will have access thereto from two points at the City terminus—one in Walbrook, immediately in front of the private entrance to the Mansion House, the other at the junction of Cheapside and Queen Victoria Street, opposite the premises of Messrs. Mappin & Webb. From these two centres stone staircases descend to the railway platforms, and when the public subway has been finished, a third means of approach will, by its means, be established. The Central London Railway Company has constructed a series of lifts at its City terminus, and if similar accommodation should be found necessary in the case of the Waterloo and City Railway, it will hereafter be provided.

Invitations addressed to British firms having failed to secure tenders which could be executed within the time specified, the rolling stock required for the new Waterloo and City line has been supplied by the Jackson and Sharp Company, of Rochester, U.S. Four complete trains have been delivered, and two others will soon be forthcoming. After construction, the stock was shipped in parts to Southampton, put together at the carriage and waggon works of the South-Western Railway Company at Eastleigh, and thence conveyed over that company's system to the Waterloo and City Railway, being transferred at Waterloo by a powerful lift which has been specially constructed for the purpose to connect the lines of the two companies.

The train consists of four coaches—two motor cars and two mid-trailers—each carriage being supported on two four-wheeled bogies. The front and rear cars are used as motor carriages, and contain two motors, the end of the motor car being fitted with all the necessary electrical appliances, which are, therefore, placed under the control of the driver. Seating accommodation is provided in each motor car for 46 passengers, and in the mid-trailers, or ordinary carriages, for 56 passengers, so that the total seating accommodation is for 204 persons; but the interior space in each car is such that, if necessary, a much larger number can be admitted. The comfortable seating of the coaches is uniform, and is, for the sake of cleanliness, made without upholstery. Each train is fitted with Westinghouse continuous compressed air brakes, which can be applied by either driver or guard to all the wheels of the train. The *maximum* speed attempted will be at the rate of 25 miles per hour, and the journey between Waterloo and the Mansion House will be accomplished in 5 minutes, a 5 minutes' service being maintained each way throughout the day.

Electrical power is supplied from a large generating station which has been established at the Waterloo end of the line. In this station are erected five boilers, engines, and dynamos, each of about 300 horse-power. The line is laid on the central-conductor principle, the conductor being a heavy channel-shaped steel rail, receiving an electrical pressure of 500 volts.

On Monday the journey to the City consumed 6 minutes 9 seconds, and the return 5 minutes 45 seconds. There was a marked decrease in speed on the somewhat heavy gradients, but no doubt this will be increased when the line is in complete working order.

The following notes were prepared on the occasion of the visit of the Municipal Electrical Association to the Waterloo and City Railway:—

The power house is entered from Anbyn Street, and contains, at present, five direct coupled Belliss-Siemens sets, although at the date of the visit only four were in place. The engines are three-crank vertical compounds of about 300 H.P., and the dynamos are of the two-pole type for 200 kw. (550 volts and 400 amperes) at 350 revolutions. The sets are fitted with very massive fly-wheels, and altogether look very substantial and business-like. The switchboard is erected upon a low gallery on the long side of the engine room, facing the generators. The panels are of white marble, and a space of 6 feet is left behind. The voltmeters are of the "Weston," and the ammeters of the "Kelvin" type. The main switches are provided with carbon breaks, and are intended to be used also as automatic circuit breakers. The two falling levers are coupled by a cross handle, and are fixed at a convenient height to give the attendant a nasty knock in the face, if they happen to fly out when he is standing in front of them for any purpose.

The boiler house lies between the engine room and the railway, and contains six boilers by Davey, Paxman & Co., Limited, fitted with Vicars's mechanical stokers. At the present time the engines exhaust directly into the atmosphere, but it is ultimately intended to use evaporative condensers.

From the booking hall inclined ways lead down to the departure and arrival platforms. These are both situated within the tunnels, but the lines terminate in a yard about 350 feet long, outside the station proper, where there are several sidings for shunting and storage purposes. On the right is a hydraulic lift, adjoining the power house, to be used for the purpose of bodily lifting car bogies up to the repairing shop when necessary. In the yard were seen cars in various stages of completion, and an excellent opportunity for close inspection was given.

The trains will be usually made up of four cars, a motor car at either end and two trailer cars in the middle. In any case a motor car at each end will be used, so that the train may be driven from either end, one car pulling and the other pushing.

Series parallel controlling gear is fixed at the end of each motor car, and the driver will always ride at the front end of the train, the switches at the two ends being interlocked. Each motor car has two Siemens's motors on the leading bogie, with the armatures mounted directly upon the wheel axles. The use of four motors on the train enables additional use to be made of the series-parallel system of control, as we can obtain—(*a*) all motors in series, (*b*) two in parallel in series with two in parallel, and (*c*) all motors in parallel, besides the intermediate resistance steps. The resistances are mounted in tubes for protection, and are fixed under the front platform of the car. Westinghouse air brakes are used, the compressed air being carried in cylinders filled every few journeys.

The cars have only one compartment each, and access is obtained either from the end platform or by a side door opening on to the station platforms. Each will hold

about 50 passengers, so that the complete train will carry about 200. All the rolling stock is of American manufacture.

The distance from Waterloo to the City terminus is about 1½ miles, and there are two distinct tunnels the whole of the way. These measure 12 feet in diameter on the straight, and 12 feet 9 inches on the curves, but below Queen Victoria Street the two tunnels run into one 23 feet in diameter, just before the City station. The line has been constructed throughout on the Greathead system, a shaft having been made on each side of the Thames, and all the excavated soil taken away in barges. The line is laid to a gauge of 4 feet 8½ inches, and is similar to an ordinary railway line. Between the metals a third rail of broad flat steel is carried upon porcelain insulators, and the joints of both metals and the third rail are heavily bonded with copper bonds. The third rail conveys current to the cars through the medium of a cast-iron shoe sliding upon it, the whole arrangement being similar to that adopted on the Liverpool overhead railway.

The feeders consist of insulated cables carried along the side of the tunnels, with disconnecting boxes at intervals. The lighting and signalling wires are carried in the same manner. Close to the rails, and connected to them at intervals, is an auxiliary uninsulated return.

It is proposed to start with a five minutes' service, and the single journey can be done in about four minutes.

The various points of interest were carefully explained by the gentlemen who guided the parties, and they had a busy time in answering all the questions which were put to them. A visit a little later on, when the whole plant is working, would doubtless be more interesting from some points of view, but it would hardly be possible to make such a close inspection of the tunnels, the track, and the cars with traffic in full swing.

TECHNICAL EDUCATION IN GREAT BRITAIN AND ON THE CONTINENT.

Sir W. H. Bailey has communicated some of his researches into the mine of history to *Cassier's Magazine*. They refer to technical education. He finds that 75 years prior to good Queen Bess, Caxton set up the first printing press in England.

About the same time before Queen Victoria, the steam engine was invented or improved into a practical and commercial success by James Watt. He might have added that about the same time previous to good Queen Anne, the invention of logarithms was made by John Napier. Most of the inventions of the reign of the first of our three queens were, however, by foreigners, and made abroad. Such were Galileo's pendulum and telescope; but of modern invention and discovery, the names of Newton, Watt, Joule, Kay, Crompton, Roberts, and a host of others, claim for England the first place as the mother of what we may term master inventions. Technical education as such, is not an English product. England appears to own her success in manufactures to the steam engine, cheap fuel, and the energy and shrewd sense of her people, for Sir William finds that we imported Dutchmen to teach us to make pumps and to bleach cloth. To-day, however, successful inventors must be scholars and educated men. Such have been and are Joule, Bessemer, and Lowthian Bell.

But we must not slacken in the race. For a century at least we have taught the world, and now they are themselves improving on many of our methods, we, too, must keep abreast and carry into mechanical pursuits the factory system which has been at the bottom of our success in textile industries.

At a recent meeting in connection with the Technical School at Coventry, Prof. Ayrton made some excellent remarks on education. Referring to Charlotte Bronte's "Shirley," he drew a parallel between the attitude of the people to machinery in the beginning of the century and to-day. As we have said in these columns, there was some excuse for those who had no knowledge of machinery to wreck what to them was an all-productive demon force. But to-day there is history to tell us what machinery has done, and there is no excuse for the machine wreckers of to-day, who, if they do not practice violence with a sledge hammer, effect the same end by more cunning means. Neither is there any excuse for the dealing with work like the few biscuits of a shipwrecked crew, which must be parcelled round. Work to-day is more like the scriptural cruse of oil and barrel of meal—it is inexhaustible.

Coventry itself stands to-day as an example of the foresight of James Starley, who saw good in the French machine of 1867, the old wooden boneshaker. Coventry adopted the cycle, and has made a fortune from it. Yet there was no demand for cycles, and no one had money to buy them. Now everyone seems able to disport on the wheel, and no one is the poorer. Nor is anyone worse off by the electric light—not even gas shareholders. Prof. Ayrton would like to have people educated in advance of the state of industry, if possible, educated to be able to act as James Starley acted, or, we might add, as Stephenson acted, in his belief in the locomotive. Stephenson's belief was better than his constructive ability, but his Rocket had the beauty of simplicity, and did not fail to fill the clauses in the prize at Rainhill, whereas better or more scientific engines failed. But it was Stephenson's mechanical perception that urged him forward. Similarly, the English invention of watch-making machinery was taken up first by Americans, who made fortunes out of machine-made watches, which ruined the Coventry trade, until revived by Rotherham, of Coventry, *in face of his workpeople's opposition.*

To-day, Rotherham's watches give points to the Americans. Prof. Ayrton had something to say on the overhead railways of America and London's underground. While the overhead and airy line has adopted electricity, the underground line sticks to sulphurous fuel, as though there were no such thing as electric traction.

The whole system underground really needs a change. The cars are too heavy, and would waste a deal of power if drawn electrically. Similarly we lag behind with our antiquated horse traction in tramways. Generally Prof. Ayrton held that what benefited the country at large would ultimately benefit each individual, and he referred to the use of 50,000 H.P. on the Boston, U.S., tramways, to show how much more employment there must be given, even if a few horse dealers be for a time inconvenienced.

DECISION ON DYNAMO REGULATION.*

Victory for Siemens-Halske Company.

An important decision has been given by the United States Circuit Court, of the northern district of New York, in the action brought by the Edison Electric Light Company against the E. G. Bernard Company and others. Basing its action on the Edison patent, of September 19th, 1882, the General Electric Company maintained that the claims covered the regulation of dynamos by compound windings. The suit was defended by the Siemens & Halske Company, whose many valuable patents would have been put in jeopardy by an adverse decision. The defence was based on the Brush patent for an improvement in dynamo-electric machines, granted July 22nd, 1879. The suit has been a very long and expensive one, having been commenced December 23rd, 1893, argued February 9th, 1898, and finally submitted to this Court March 9th, 1898.

The decision of the court in part was ;—

"Although this record has been expanded beyond reason and precedent, it will be noted that the real issue is one of the simplest that can arise in a patent cause, viz., whether the patent is invalidated by a single prior patent.

"The best evidence of what the patent covers is the patent itself. It states that it is for 'a new and useful improvement in regulating the generative capacity of dynamo-electric machines.' The claims are for the dynamo in combination with translating devices in multiple arc ; but as this arrangement of translators has been well known since

* *Street Railway Review.*

1875, invention cannot be predicated of this element of the combination; indeed, there is no pretence that it can be. If invention can be found at all it must, therefore, be in the dynamo.

"The combination of the first claim contains the following elements:—

"1. A dynamo. 2. Translating devices arranged in multiple arc. 3. Field circuit of constant resistance for primarily energising the field magnet. 4. Another field circuit whose resistance is varied by the addition and removal of translating devices.

"The elements of the other claims are substantially similar, and in view of the conclusion reached, it is unnecessary to consider them in detail. Claim 3 differs from the other two, in that the shunt circuit must be supplied from the main conductors.

"It will be seen that the first claim is not for a dynamo of the Edison type, or for the system of electric lighting adopted by him, but, on the contrary, that it is broad enough to cover, and does cover, any dynamo having the described characteristics in combination with any translators in multiple arc.

"The Brush patent relied upon by the defendants was applied for 17 months before, and was granted one month before the earliest date fixed for the alleged Edison invention.

"The Brush patent is for an improvement in dynamo-electric machines, and has for its object the maintenance in such machines of a magnetic field while the machine is running, whether the external circuit is closed or open.

"Without analysing the patent in detail, suffice it to say that the description is specific, carefully drawn and clearly illustrated by diagrams. The dynamo of the patent is a compound-wound dynamo having a shunt and series coil, the former of high resistance and the latter of low resistance. In some of the figures the series coil is wound over the shunt coil; in others the shunt is wound over the series, and in another figure the two cells are wound on opposite ends of the same core. The dynamo is designed to generate and maintain a sufficiently constant electromotive force and produce an amount of current always corresponding to the amount needed by the devices in the working circuit. Mr. Brush shows his machine in combination with electro-plating in multiple arc, and Mr. Edison shows his in combination with electric lighting in multiple arc. This is the principal distinction between the two. If the one multiple arc circuit be the equivalent of the other, then it cannot be denied that every element of the patent in suit is found singly and in analogous congeries in the Brush patent, and that they are described there so as to be more readily understood, at least to the uneducated lay mind, than in the Edison patent.

"Not only is this clear from the Brush patent, but the proof shows that a number of machines were built pursuant to its directions, and were commercially used more than two years prior to the date of the application for the Edison patent. These machines exist at the present day, and what is quite remarkable and almost unique in patent litigation is the fact that, in an art which has progressed with giant strides, machines made nearly 20 years ago are not only operative, but practically as successful as when first built. Two of these working dynamos have been introduced in evidence, one by the complainant and one by the defendants. Each is capable of doing the same work now as in 1880.

"The complainant's proposition, if sustained, would lead to the conclusion that Mr. Brush, after having obtained his patent in which the dynamo is described as suitable for an electro-plating circuit, could have attached the same dynamo to a well-known lamp circuit and have obtained another patent for that, and so on, as often as he changed the character of the translators.

"Even though this work required enlargement, adjustment, and some change in the winding, it would still be a question of degree within the realm of the skilled mechanic.

"To restrict the Brush patent to electro-plating would be as unfair as to restrict Edison's to electric lighting. The one illustrates his dynamo in connection with the first-named translating devices, and the other with the second-named devices.

"But even were there more doubt as to the correctness of the conclusion reached, the court should still hesitate to enforce a patent in the sixteenth year of its age, and thus lay the entire art under tribute, when the public has had a right to assume that such a system as the defendants are using would not be molested.

"The Bill is dismissed."

A POWERFUL ELECTRO-MAGNET.*

WE are now able to give the exact figures of the construction of the electro-magnet designed by M. Pierre Weiss, and described in our number of June 17th last. It is of considerable interest, as giving very intense fields with very moderate dimensions.

Fig. 1 shows its arrangement and proportions. The large bobbin carries 2,200 turns of wire, and each of the small

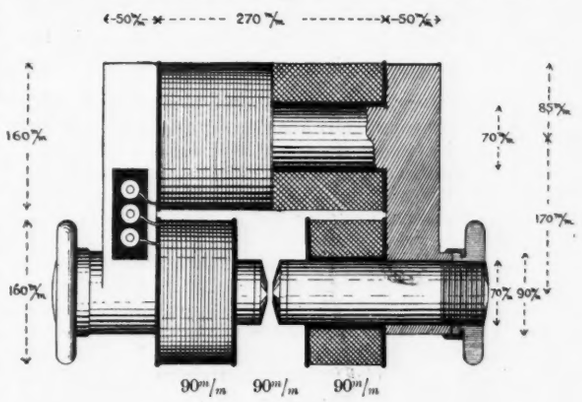


FIG. 1.

bobbins 600 turns. The wire is of 2 mm. diameter, and carries a current of 9 amperes for two hours consecutively, or 14 amperes for 10 minutes, without excessive heating.

In addition to these, two bobbins (see fig. 3), each carrying 200 turns, can be placed on the pole pieces close to the gap, giving in all a possible magnetising force of 63,000 turns. The largest amount used is said to be 50,000 turns. The resistance of the circuit is 9 ohms.

Several sets of pole pieces are used, and are shown in fig. 2. Pole pieces, *a*, give a large uniform field of about

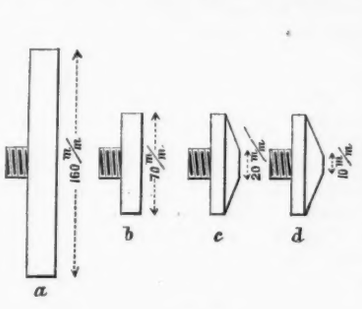


FIG. 2.

FIG. 3.

2,000 units; pole pieces, *b*, a smaller, but still fairly uniform, field, of about 20,000 units; while *c* and *d* are used for small and very intense fields up to 30,000 units.

A good deal of M. Sagnac's paper was occupied with a discussion of the correct angle to be given to conical pole pieces, following the lines of Ewing's reasoning, and an angle of 120° is selected as a mean value. For this we may refer our readers to the original paper.

THE RELATION OF CHEMISTRY TO ELECTRICAL ENGINEERING.

A PREDICTION as to the future possibilities of electricity would hardly be complete without a mention of its applica-

* See page 835 of our issue of June 17th, 1898.

tion to chemistry, and the probabilities are that developments in the near future will show even more clearly than at present the close relationship between chemistry and electricity.

The science of electro-chemistry is one of great importance to the electrical engineer from two opposite points of view. The promise has been made that discoveries in this science will furnish the means of transforming chemical into electrical energy whereby energy in a useful form may be obtained direct from coal; and if this promise is fulfilled, even to the extent of economically transforming 10 per cent. of the energy of carbon directly into electrical energy, the influence on the present methods of power generation can hardly be estimated. On the other hand, the transformation of electrical into chemical energy offers the electrical engineer an advantageous method of disposing of energy in the manufacture of useful chemical products. The former prospect is one almost entirely of the future, while the latter is already one of industrial importance at the present time.

In the whole engineering field there is probably no section about which less is generally known, and in which the refinements of the best engineering practice have been less applied than in electro-chemistry. From its great importance and the wonderful possibilities presented by it, such a condition of affairs may seem surprising, but it may possibly be attributed to the fact that all who have been actively engaged in this line of work very jealously keep their processes secret, and what has actually been accomplished in this field, and the knowledge of methods used is by no means common property. Some of the leading manufacturers using electro-metallurgical and electro-chemical processes, frankly admit that it is not their policy to take into their employ ambitious young men of technical training to learn the business unless they are financially interested, and that it is to their interest to keep the details of their business in as few hands as possible.

Although there is apparently a considerable amount of electro-chemical literature, a large part of it is unreliable and misleading from the fact that it is largely derived from patent specifications, in which any number of claims are made, but no reasons are given as to why these claims cannot be realised in practice, and there is a remarkable dearth of published data derived from practical working on an industrial scale.

The advantages to be derived from electro-chemical industries are manifest to both the chemist and the electrical engineer, for to the former it means a new and cheaper method of manufacture and the possibility of obtaining substances which could be obtained in no other way; while to the latter it offers a possible means of solving some of his hardest problems, such as the utilisation of water-power without long-distance transmission, and the raising of the central station load factor to a value which will enable the equipment to be utilised to its full extent. That some progress in this direction is being made is shown by the fact that over one-half of the power contracted for at Niagara Falls is to be used in electro-chemical processes.

The consumption of energy for electro-chemical or electro-metallurgical processes seems to offer an ideal solution for the second problem. This is especially true if the operation is one that can be started and stopped at any time, and in which the amount of power may be varied at will. With such a condition of affairs we should have a load greatly superior to any day load at present in that it would be absolutely steady and would not overlap the lighting load. Although such a load could be obtained by an efficient method of power storage, all methods which have been proposed for this purpose involve a large percentage of loss in the transformation of energy, as well as an expensive equipment, which greatly increases those important items on the books of central stations, namely, "interest" and "depreciation." If the surplus energy could be utilised in producing some marketable product, the interest and depreciation upon the extra investment would represent a portion of the cost of the article produced, and would not enter as an item of expense into the operation of the power station.

From the chemical engineer's standpoint, the question is: Where can power be obtained in sufficient quantity and at a low price? He might obtain it from the central station, paying for it at the usual lighting rates. A greatly reduced rate could be obtained from the same station, however, if the power is to be used only during certain portions of the day; that is, when there is slight demand for lighting current. In order, however, to avail himself of this rate, the cost of the electrolytic equipment for utilising the current must be low enough so that the interest and fixed charges upon the capital invested in apparatus shall not be great enough while the apparatus is not in use, to offset the saving made by the reduced rate for power. If large and continual amounts of power are required, an efficient steam plant might furnish the energy at a small cost per H.P.-hour. The utilisation of water-power seems to be the ideal source of supply for electro-chemical work; but here, again, a limit is placed, from the fact that if the power is at a considerable distance from industrial centres, the transportation rates on the raw material and the finished products will generally overbalance the saving made in the cost of power, and as a result, electrolytic industries deriving power from steam plants are successfully competing with water-driven installations.

Among other sources of cheap energy which may enter into competition may be included power plants located near coal fields, where fuel obtained at the actual cost of mining could be used; also power plants deriving their energy from the waste gases of blast furnaces and coke ovens, which energy is far more than sufficient to supply the power now utilised in such works. The principal problem for the chemist, then, is not how to obtain a cheap source of energy, but to develop and perfect the electrolytic apparatus, so that the energy may be utilised.

There is a very substantial paper on this subject by Mr. C. F. Burgess in the *Wisconsin Engineer*, Vol. ii., No. 2, pages 134—142, which is well worth careful perusal by those of our readers who are responding to the growing interest in electro-chemical work. Mr. Burgess not only indicates the directions in which new enterprises may possibly succeed, but, which is equally valuable, points out the roads along which those who travel will encounter failure.

The paper contains a scholarly classification of the chemical changes which can be effected by an electric current, and explains the properties by virtue of which these changes are brought about, and then comes illustrations from processes which are actually being commercially exploited at the present time. Papers such as his are most acceptable at the present time, when some of the best men amongst us, not to mention some of the most substantial capitalists, are being attracted to the problems of industrial electro-chemistry.

GENERAL POWER DISTRIBUTING COMPANY'S BILL.

A CONTEMPORARY, referring to the recent correspondence which has appeared in the public press with regard to the above Bill, makes the following note:—

> But in the particular instance selected by Mr. Hammond, with a view to illustrate his argument, he has entirely ignored the fact that the company about to commence supply is *to be bound down not to compete* with the local authorities.

We can imagine the amusement which this paragraph must have afforded to the promoters of the Bill, whose chief aim is to secure the right of competition in the large cities and towns embraced in their area.

The fight which Mr. Robert Hammond is waging on behalf of the city of Sheffield, Dr. Hopkinson on behalf of the city of Nottingham, and Prof. Kennedy on behalf of the town of Rotherham, is to prohibit the company from introducing a competitive supply, and the naïve note of our contemporary quoted above must have afforded equal amusement to these gentlemen as to the promoters of the Bill, for the one object for which they are striving is treated by our contemporary as one that has already been achieved.

Those who followed the proceedings of Lord Northbrook's Committee until it finally disposed of this Bill, are, of course, aware that the calm *ipse dixit* of our contemporary is based upon an absolute misapprehension. It is, of course, always dangerous to rely upon second-hand information, and doubly so in a case where the slightest ambiguity in the

report may lead to a total misconception. Possibly some of our readers may also have been misled as to the actual position of this most important Bill, and we therefore think it well to make clear the present position.

As presented to the House of Lords Committee, it was very far sweeping in its scope, the area of supply set out in the first schedule being described as follows :—

The area within which the company intend to supply electricity comprises so much of the counties of Derby, Nottingham, Lincoln, and the West Riding of the county of York as is contained by a circle drawn upon the map of England at a radius of 26 miles from the north-west corner of the parish church of Warsop, in the said county of Nottingham, and all cities, county, and other boroughs, towns, villages, urban districts, rural districts, parishes, extra-parochial and other places within the county and parts of counties before mentioned.

It will be seen that there was not excluded the area of a single local authority, but between the drafting of the Bill and its consideration before committee, two local authorities included in the area had apparently come to terms with the company and obtained exemption from the operations of the Bill, those two local authorities being the towns of Derby and the Urban District Council of Hoyland Nether.

During the progress of the Bill in Committee, the promoters of the company offered a clause providing for the exemption from competition of those local authorities who were willing to obtain from the company a supply in bulk, but this clause was so hampered with stipulations that it was not accepted by the opposing corporations. It will be remembered that when the preamble of the Bill was declared to be proved, the representatives of the opposing corporations left the room in order to reserve to themselves the right of opposition in the other House. In their absence, on a subsequent day, the clauses of the Bill were duly considered, with the result that Clause 37*a* was introduced and accepted by the Committee in the following form :—

The following provisions shall apply, except so far as may be agreed to the contrary between the company and the corporation of any borough which shall be supplying electric energy under an order or Act empowering such corporation to supply electric energy, or shall have obtained such order or Act:—

1. The company shall, six calendar months before commencing to distribute electrical energy within any such borough, give notice in writing of their desire so to do to the corporation, and the corporation shall, within three months after receiving such notice, be entitled to serve upon the company a counter notice indicating their desire to undertake such distribution themselves, and to purchase from the company a supply in bulk. The terms of such supply in bulk as to price, minimum amount, and all other details shall, failing agreement between the company and the corporation be determined by an arbitrator, and the corporation shall be at liberty to enter into an undertaking to take from the company a supply in bulk, according to the terms so agreed or settled by arbitration as aforesaid, for a period of three years at the least, and thereupon the company shall, save as hereinafter mentioned, be restrained for such period from distributing electrical energy under the power of this Act within the said borough.

2. In the event of the corporation failing to give such counter notice, or, having given the same, failing to enter into such undertaking to take a supply in bulk, the company's powers to supply within such borough shall be unaffected by the provisions of this section.

3. Provided that if three months before the end of the said period of three years, and any subsequent period of three years, the corporation shall give notice of their desire to continue the taking of a supply in bulk, the company shall continue to give such supply at a price and minimum amount to be agreed between the parties, or, failing agreement, to be determined by arbitration in the manner hereinbefore provided, and thereupon the provisions of this section shall apply to the extended period.

4. Whenever the company makes default in supplying energy in bulk to the corporation as aforesaid the company shall be liable to pay and shall pay to the corporation, in addition to the penalties for failure to supply by this Act provided in the case of any owner or occupier, all damages, expenses, costs, charges, and expenses which the corporation may be under liability to pay or shall have paid in respect of failure of supply or pressure, which liability shall have arisen by reason of the default of the company as aforesaid, and the amount of such penalties shall not be limited by anything contained in the section of this Act, the marginal note whereof is "Penalty for failure to supply."

Provided that in any event the company shall be at liberty to supply to any person within such area, for trade purposes, who is willing to undertake to receive a supply of not less than 10,000 Board of Trade units per annum.

Unless the above clause be modified in the House of Commons it will be noted that :—

(*a*) The company will have power to compete with the local authorities in the case of consumers taking 10,000 Board of Trade units per annum and upwards.

(*b*) They will only withhold competition in the case of consumers taking less than 10,000 units per annum on the local authority agreeing to take electricity in bulk.

Manifestly if the House of Commons confirms the action of the House of Lords, and shows itself prepared to grant powers of supply over areas of 2,000 square miles to any company whose enterprise leads it to be first in the field, there will be, in the coming session, a shoal of such applications embracing probably the whole of the United Kingdom in their operations, and thereby reducing the value of the 200 provisional orders at present held by local authorities.

Though only some half-a-dozen local authorities, holding provisional orders, are directly affected by the present Bill, the whole of the local authorities throughout England are jointly interested with them in defeating the Bill. We understand that the Municipal Corporations Association is calling upon all its members to use their best endeavours to defeat the Bill in the House of Commons, or at all events to endeavour to get introduced in the Bill the clause which our contemporary deems to be already there.

CORRESPONDENCE.

Helios v. Braulik.

An inaccuracy has occurred in your report of my evidence in the above case. I did not state that the Crompton lamp had no reflector when received by me, but quite the reverse. It had the same reflector then as it possessed when produced in Court, but the bridge piece had inadvertently been turned upside down.

I stated that the insulator in the bridge piece which was there originally was now missing, but that no globe had been sent with the lamp some 14 or 15 years ago. Your report would imply that a reflector had subsequently been fixed.

J. Hayton Greenhill.

Belfast, *July 11th*, 1898.

Arc Lighting.

Our attention has been called to the advertisement of Messrs. Johnson & Phillips on the front page of your issue of July 8th with reference to the lighting of Portsmouth. This advertisement is calculated to produce the impression that Messrs. Johnson & Phillips are still in a position to supply lamps similar to those supplied by them for the lighting of Portsmouth, whereas the facts are, that these are Brockie-Pell lamps under license from Messrs. Brockie and Pell.

Messrs. Johnson & Phillips have no longer any license to manufacture or sell these lamps, which can now only be obtained from this company.

We shall be obliged by your inserting this in your next issue.

Brockie-Pell Arc Lamp, Limited.
William Shrimpton, *Managing Director.*

The Meeting of Messrs. Thomas Parker, Limited.

I notice that in your report of the annual meeting of Messrs. Thomas Parker, Limited, Wolverhampton, that took place last Tuesday, appearing in your paper of the 8th inst., I wish to correct a statement that was reported I had made.

I inquired what they allowed for depreciation of machinery, and was reported as having said "that it was old machinery, it was only worth scrap iron." This is an entirely incorrect interpretation, and what I did say, was "that if the machinery was not always kept up with renewals, and also not up to date, then it could be regarded as 'old machinery, and only worth scrap iron.'" The cost of repairs, renewals, and keeping machinery in first-class order is generally large, and that was the reason that I inquired what they allowed for depreciation for the same.

Thomas Smith Heaton.

Re Worcester Waterworks Alternating Motors.

We notice in the paper which appears in your issue of 8th inst., on "The Practical Use of Single-phase Alternating Motors," by Mr. E. E. Hoadley, a statement that the two 30-H.P. motors in use at the Worcester waterworks were made by the Oerlikon Co., Zurich. As our senior was responsible to the contractors who erected these motors, the Brush Electrical Engineering Co., Limited, we are able to inform you that they were manufactured by Messrs. Brown, Boveri & Co., of Baden.

As we are acting as agents for Messrs. Thomas Richardson & Sons, of Hartlepool, who hold the concession for the manufacture of Brown-Boveri plant in this country, we write to ask you to kindly make the above correction.

We take note of Mr. Hoadley's remarks as to their high efficiency, which fully confirm the tests which our senior himself made at the time these motors were put into use several years ago, and we venture to think that his (Mr. Hoadley's) statement which reads as follows:—"The motors are started up by *the stoker or labourer* on duty at the waterworks, and once started need no attendance, skilled or otherwise, for as soon as they are started the door of the motor house is locked and the stoker goes back to his fires," is a highly satisfactory testimonial to the practical working of the Brown-Boveri alternating motors.

Geipel & Lange.

A Correction.

I am informed that at the end of your description of the Wakefield Electricity Works you say that before I took up my position at Wakefield I was "at the works of the Yorkshire House-to-House Company," by which it may be inferred that I was in the employ of that company. This is an error, my only connection with that company was in the position of superintending engineer, representing Mr. Robert Hammond, for a period of about two months during the erection of one of the new plants.

J. K. Brydges,
City Electrical Engineer, Wakefield.

An Electrical Gear for Motor Cars.

I have read with much interest the short article in your issue of June 24th last, on "An Electrical Gear for Motor Cars," proposed by Mr. William Morrison, "the Chicago inventor."

It may be of interest to record the fact that the same idea occurred to Mr. John Fielding, M.I.C.E. (of Messrs. Fielding and Platt, Limited), about a year ago, and he obtained provisional protection for it.

In August, 1897, we jointly made a number of experiments to put such an arrangement to the test.

A small oil engine was belted to the pulley of a half H.P. dynamo, and drove the armature at constant speed.

The fields (which were of the Manchester type and readily balanced) were supported on bearings at the outer end of each armature bearing, and were free to revolve therein.

Two insulated brass rings revolved with the field magnets, and to these the dynamo was series connected, a variable resistance being used to close the circuit between two stationary brushes which made contact, one with each ring.

A pulley fixed outside the field magnets, and to which a brake could be applied, completed the arrangement.

To obtain the rated power from the motor it was necessary to provide at least double the ordinary speed on the armature driven by the engine, so that the *relative* speed between the armature and fields had the normal difference when the latter were revolving.

For instance, if the motor gave ½ B.H.P. at 1,000 revolutions per minute when supplied with current under ordinary conditions, then the armature had to be driven at approximately 2,000 revolutions in order to obtain ½ B.H.P. from the revolving fields.

It is evident the usual speed reducing gear between the motor and the driving-wheel of a vehicle would be required, because in order to obtain direct coupling to the driving axle, a large torque would be needed to start the vehicle from a state of rest, and necessitating a slow speed dynamo of such size and weight as to be prohibitive.

As regards reversing, it would be possible to reverse the motor by having an open and crossed belt from the engine, but a mechanical gear between the motor and driving wheels, as you suggest, seems the more practicable method.

Whether this system of transmission can be proved to be as "ideal" in practice as it at first appears, has yet to be proved.

Query—What would be the efficiency of the combination under the most favourable conditions?

W. A. Walton, A.I.E.E.

Gloucester.

ELECTRIC LIGHTING PROVISIONAL ORDERS.

The Parliamentary Committee on Private Bills, presided over by Sir A. F. Godson, had before them on Tuesday last applications for provisional electric lighting orders from the parishes of St. Marylebone and Bermondsey. The Bermondsey order was considered first, the Counsel appearing for the Vestry being Mr. Littler, Q.C., and Mr. Gerald Fitzgerald; the opposing company—the London Electric Supply Corporation—being represented by Mr. Pember, Q.C., and Mr. Pembroke Stephens, Q.C.

Mr. Littler, in opening the case for the Vestry, said the application was one for the confirmation of an order made by the Board of Trade to enable them to supply electric energy for lighting and other purposes in Bermondsey. There was already a company in the parish, the London Electric Supply Corporation, which professed to supply electrical power, but although they had had the power since 1889, up to the present moment they had only supplied a very small part indeed of their compulsory area. They had laid trunk mains through the parish, one in 1883 and one in 1897, but they were a company which supplied a considerable number of other places besides Bermondsey. They had laid out some £5,000, but by reason of their non-supply over their compulsory area they had rendered themselves liable to penalties amounting to £50,000 for not doing their duty. The company was now in the hands of a receiver. The Vestry had applied to them on various occasions for light, and the Conservative Club and various other institutions in the parish had asked for the light, but they had never been able to get it. The consequence was, that the Vestry felt themselves compelled to do something in the matter themselves. The supply of the company was not a satisfactory one where it was given, for it was on the alternating system, instead of the continuous system. Their application was on exactly the same lines as that of the Newington Vestry, whose provisional order had been confirmed by Parliament. He would remind the Committee that the whole of the matter of the Bermondsey application was discussed in the House of Commons on the second reading of the Bill, and it was worthy of notice that there was not a single opposing voice raised in the parish against the Vestry incurring the proposed expenditure. The area of Bermondsey was 627 acres, and the gross rateable value was £427,000. Newington, which had already obtained an order, had a rateable value of £501,000. They were in the position of many other London parishes of finding increasing difficulty in getting rid of their refuse and waste and general filth. What they proposed to do was to utilise this refuse in providing the heat which would be required for the purposes of their electric light, and the consequence would be an enormous saving to the parish in that one item. They also proposed to light the public lamps at the very lowest price. They reckoned they would be able to do it about 2d. per Board of Trade unit, whereas the cheapest they could get the light from the company was 3d. per unit. In addition, they would be able to supply private consumers as low, if not lower than the company were doing.

Evidence was then called in support of the application.

Mr. J. E. Waller, consulting engineer, replying to Mr. Fitzgerald, said the Newington order was the only case in which the local authorities had been given powers against an existing company. The London Electric Supply Corporation worked on the high tension alternating system, but the Bermondsey Vestry proposed to work on the low tension continuous system, which had many advantages over the other. The present company had never taken any steps to get customers in its compulsory area, and they only supplied a very small portion of the area. He was of opinion that the Vestry would be able to supply electrical power for public lighting at an expense of 2d. per Board of Trade unit, and to private consumers at 6d. He then instanced the advantages which had accrued to the public from local authorities undertaking the supply. In the case of St. Pancras the electricity only cost the Vestry 2·76d. per Board of Trade unit, and they sold it at 5·23d. The Metropolitan Electric Supply Corporation worked at an expense of 4·13d. per unit, and their average charge was 6·35d. He was decidedly in favour of municipalities supplying electric power as against private companies.

Cross-examined by Mr. Pembroke Stephens: He estimated the cost of the generating station at £15,635, and the dust destructor would cost another £10,000, exclusive of land.

Dr. Hugh Mansfield Robinson, vestry clerk and solicitor to the Shoreditch Vestry, gave evidence as to the advantages which that parish had derived from the supply of electricity. He stated that up to June 24th of this year, which was the first complete year

the Vestry had supplied the light, they had made a gross profit of £4,954, and deducting the interest on loans, and the provision for the sinking fund, the net profit had amounted to £2,303. They had destroyed 25,000 tons of refuse, and there had been a saving in that item of £740, which, added to the profit already referred to, made a net profit of £3,043.

Mr. T. Cox, chairman of the Electric Lighting Committee of the Bermondsey Vestry, Mr. E. Gough Clarke, assistant clerk to the Vestry, and Mr. L. Joseph Dunham, clerk to the Kensington Vestry, also gave evidence in favour of the application, after which the Committee adjourned until the following morning.

Bermondsey Provisional Order.

The House of Commons Committee sat again on Wednesday to consider the application of the Bermondsey Vestry for an electric lighting order.

Mr. Robert Stewart Bain, managing director of the London Electric Supply Corporation, continued his evidence against the application. The Electric Supply Corporation had been in existence for 10 years, and had spent £1,000,000 in capital, and were about to issue a further £100,000 4 per cent. debenture stock, the whole of which had been applied for. He thought it impossible for the Vestry to supply electricity for public lighting at anything like 2d. a unit, or double that. As regarded private lighting, it was entirely opposed to his experience that anything like 20 units would be consumed in a poor parish like Bermondsey. His experience was that 12 units per lamp was the very outside that would be consumed, and that was for the best class of houses, such as public houses and large shopkeepers. The average of the whole of their supply, taking in such places as the Alhambra and Pavilion, and many other theatres, was 18 units. He considered that the interest and sinking fund on the money which the Vestry would have to borrow to erect the generating station and plant would eat up all the revenue they would derive, without leaving anything for the cost of production. He was confident that a station as proposed by the Bermondsey Vestry would result in a loss to the ratepayers.

Cross-examined by Mr. Littler, Witness said the reason they objected to the loss of ratepayers' money was that it would mean competition to them. It was true there was no demand at present in the parish, but the company were looking to the demand to increase. They did not consider that it was fair competition on the part of the Vestry to compete against them, considering that the Vestry could purchase at the end of 42 years. The cost of production to them, notwithstanding their great supply, cost them over 3d. a unit.

Can you name any one company with a higher cost of production than yours?—So far as the published statements of the Metropolitan Company are concerned—which, I may say, are not reliable—they are more than ours.

Continuing, Witness said that the accounts of the Shoreditch Vestry showed a loss on the electric lighting. He impugned the accuracy of the figures to the extent that £2 9s. 9d. represented the total cost of the distribution of electricity in Shoreditch for one year.

Are you or are you not going to pledge yourself to the Committee to extend your mains?—We shall extend our mains where there is a demand.

Mr. Littler: That means you won't.

Re-examined by Mr. Stephens, Witness said there had not been a single demand made by a tradesman of Bermondsey which they were not prepared to meet. He considered that it was a great hardship that the Vestry, of all bodies in the world, should come in to compete in Bermondsey.

Mr. Littler characterised the position taken up by the company as extraordinary, for it was entirely opposed to the provisions of the Act. The only question for the Committee was whether it was a suitable application. The company had only spent £5,000 on the parish, and that in a corner where none expected them to do much. People would not take the light before they saw it at their doors, and that was what the Vestry intended to arrange for. The parish and the parish authorities were unanimous in going on with the matter in the interests of the parish, and there was no reason why the order should not be confirmed.

The decision was suspended until after the hearing of the application for confirmation of the Marylebone order.

Marylebone Provisional Order.

The Committee proceeded to consider the application of the Marylebone Vestry for confirmation of a provisional lighting order. Mr. Worsley Taylor, Q.C.; Mr. Freeman, Q.C.; and Mr. H. Hamilton represented the Vestry: and Mr. Balfour Browne, Q.C.; Mr. J. D. Fitzgerald, Q.C., and Mr. Moon, appeared for the Metropolitan Electric Supply Corporation, who were in possession of the area, and opposed the order.

Mr. Worsley Taylor said the object of the Bill was to confirm the provisional order granted by the Board of Trade under the Act authorising the Vestry to supply electrical energy within their area, and the system proposed to be given was the low pressure continuous current. The area of the parish was 1,509 acres, and the rateable value £1,609,000. The Metropolitan Electric Supply Corporation was already in existence supplying electricity for purposes mainly of electric lighting. The company had their cables laid in a considerable part of the parish, but only in part, and their system was the high pressure alternating. There were two questions to be considered, (1) should there be an alternative system of supply in the parish by somebody, and (2) if it is right that there should be an alternative supply in the hand of someone, is it right that that body should be the local authority. Competition had been recognised from the outset by the Board of Trade, and it was the opinion of the Board that where there were two competing companies in an area they should have different systems. In a number of areas smaller than that of Marylebone there was competition, and if another company went to Parliament to obtain an order to compete in the district there was no doubt that the application would be granted. That session two applications had been made to the Vestry to allow competition, and one petition in favour of allowing a company to compete had been signed by 2,000 ratepayers. There was no distinction to be drawn between another company or the local authority coming in to compete. It was with a perfect knowledge of this that the company embarked its capital in the Marylebone undertaking. The Vestry never intended to part with the right, to let another company in, or debar themselves from coming in, and that was perfectly well understood by the company. The Metropolitan Company supplied Marylebone, and had two generating stations in the parish, but under a Bill which had passed through another House, the company would have power to go to Willesden to make a central generating station. It was admitted that that was partly to supply the deficiencies which at present existed in Marylebone. But that station at Willesden was not to supply Marylebone alone and they had to consider what was going to happen when the time for purchase came. The local authority would certainly be unable to purchase the generating station at Willesden, and in other words, what it came to was that purchase would become a dead letter. If another company was allowed to come in, the difficulties would be increased. He contended that the mere fact that the company did not like opposition was no ground of objection. But companies did not mind meeting with what was called rate-aided competition, and the Metropolitan Company itself had given notice to apply for a provisional order for Shoreditch.

Mr. T. B. Hitching, member of the Vestry of Marylebone, and chairman of the Electric Lighting Committee of the Vestry, said the Vestry were of opinion that, in the interests of the parish, there should be a competitive supply of electricity, and that it should be done by the Vestry rather than that another company should come in. Up to the present time the Metropolitan Company had not met all the requirements of the parish, and he believed if there was competition they would get better light at a cheaper rate, and the poorer classes would then be able to get the light. If there were two sources of supply, they would be safe in the case of accident, for on two occasions they had been placed in darkness, owing to fires at the generating station. The Vestry believe that there was sufficient demand in the parish both for the company and the Vestry, for the Vestry would be able to meet certain demands by their system better than the company. They did not think it would interfere with the company much. He believed the undertaking would be remunerative to the Vestry. After they had provided 5 per cent. for interest and sinking fund the rest of the profit could go to decrease the price, which would tend greatly to increase the demand. They would be able to work the generating station with a dust destructor.

By Mr. Balfour Browne: He knew that the company were obliged to lay mains when they were requisitioned. He did not know that there were 122 miles of mains laid in the parish by the company. He admitted that they had obstructed the laying of mains by the company. They had no official notice that the company were putting down plant to supply continuous current.

At this point the Committee adjourned.

LEGAL.

Cooper v. the Electrical Installation Company, Limited, and Others.

In the Court of Appeal on Monday, before the Master of the Rolls and Lord Justice Chitty, the case of Cooper *v.* the Electrical Installation Company, Limited, and the O'Brien Leonard Company, which had been before their Lordships on appeal by the plaintiff from an order of Mr. Justice Channell, who had struck out the statement of claim as showing no reasonable cause of action, was again mentioned. The case had stood over to see whether the parties could not come to some arrangement for the settlement of the whole litigation.

Mr. G. Wallis, who was for the respondents, said he was sorry to say no agreement had been arrived at.

The Master of the Rolls said there was nothing for it, then, but to dispose of the appeal. The case was a little peculiar, because this was not the first time that an application to strike out the statement of claim had been made. The action was by Mr. Cooper against the Installation and the O'Brien Companies, and the O'Brien Company had obtained an order striking out the statement of claim as against them but with liberty to amend. The plaintiff had amended his statement of claim, but the O'Brien Company still said that there was no cause of action against them, and Mr. Justice Channell had taken that view. It appeared to him on looking through the claim that even now no cause of action was shown against the O'Brien Company. It seemed that the plaintiff and the Installation Company were joint owners or were jointly interested in some patents. The plaintiff assigned his interest to the Installation Company upon certain terms, and he alleged that there had been breaches of those conditions both by the Installation Company and by the O'Brien Company, and damages were claimed. Well, as to that, the Court of Appeal had said before, and now said, that so far as this was an action for damages against the O'Brien Company, the claim could not stand. All the particulars of claim, with no exception, were open to objection, however much the plaintiff might amend. It appeared that most of the patents were disposed of, but there was still one, called the Safety Wall Plug, which had been worked, not by the Installation Company, and still less by the O'Brien Company, but by Messrs. Hodges & Todd, who

were the sole licensees of the Installation Company. The plaintiff claimed to recover against the O'Brien Company on the ground that they had worked under the license, but the statement of claim did not show that the O'Brien Company had received anything, and the claim therefore failed. The appeal would therefore be dismissed, and with costs.

Lord Justice CHITTY, in concurring, said the mere statement that the O'Brien Company had received profits was not sufficient.

The appeal was accordingly dismissed with costs.

LAMINA ACCUMULATOR COMPANIES.

A MOTION in *re* the Lamina Accumulator (Elieson's British Patents) Syndicate, Limited, and in the matter of the Elieson Lamina Accumulator Company, Limited, the Earl of Galloway *v.* the Lamina Accumulator (Elieson's British Patents) Syndicate, Limited, came before Mr. Justice Kekewich in the Chancery Division last Friday.

Mr. WARMINGTON, Q.C., (with him Mr. Mac Swinney), said he had to move on behalf of the Earl of Galloway for the appointment of a receiver. The principal ground on which the application was made was that the company who were the purchasers of the assets of the syndicate by which the debentures held by the Earl of Galloway were granted, were threatening to place a charge of £4,500 on these assets in priority to the debentures in question. The motion was originally before his Lordship on June 10th, and stood over on terms. In pursuance of these terms the company had paid £1,000 to the bankers for Lord Galloway's security, and had also paid the interest on the debentures down to June 30th, but no payment had been made in respect of the principal of the debentures, nor had they done what they were bound to do by their agreement with the syndicate, viz., issue to the Earl of Galloway debentures in the company in lieu of the debentures he held in the syndicate.

Mr. BRAMWELL DAVIS, Q.C., said he appeared for the company, who were as anxious to give his lordship the debentures as he was to receive them, but they could not get the liquidator of the old syndicate to settle the matter.

Mr. CUTLER, Q.C.: I appear for the syndicate. The liquidator writes that he would be happy to render assistance, but requires certain accounts for small amounts first to be paid.

It was ordered that the motion should stand over for a fortnight on terms, "to enable new debentures to be issued pursuant to the agreement, the company undertaking to carry on business in the usual way, and not to create any prior charge in the meantime."

BANKRUPTCY PROCEEDINGS.

THE creditors of Edward Augustus Ingold, electrical engineer and accessories merchant, 66, Wandsworth Bridge Road, Walham Green, met last Tuesday at the London Bankruptcy Court. The debtor started in the beginning of 1892 with £150 capital, derived from previous savings, at Woodlands Road, Ilford, removing two years later to his present address. He has also traded in partnership with others. Then in March, 1898, he took premises at 3, Featherstone Buildings, Holborn, and traded there until recently, when he gave up the premises, being unable to pay the rent. He attributes his insolvency to loss on the trading, a loss of about £300 that he had expended in the proposed flotation of the Phœnix Electrical Maintenance Company, loss of about £2,000 by betting during the past five years, and to his liability for moneys borrowed to satisfy gambling debts. The accounts filed show liabilities £1,790 10s., against assets £2, exclusive of book debts £304, to which no value is attached. In the absence of any offer, the case was left in the hands of the Official Receiver to be wound up in bankruptcy.

WESTMINSTER ELECTRIC SUPPLY CORPORATION.

BEFORE Mr. Justice Kekewich, in the Chancery Division yesterday (Thursday last week), a motion was in the matter of Kirk & Rendell *v.* The Westminster Electrical Supply Corporation, Limited, for an injunction to restrain the defendant company from taking possession of certain works now in the course of erection which the plaintiffs were under contract to construct for them.

Mr. Butcher, Q.C., appeared in support of the motion, and Mr. Warmington, Q.C., Mr. Roger Wallace, Q.C., and Mr. Platt for the defendant company.

Mr. BUTCHER said the plaintiffs were a firm of builders and contractors, and under a contract dated September 23rd, 1896, they undertook the construction for the Westminster Electrical Supply Corporation of certain works for the supply of electric light. The construction had been going on for a considerable time, as plaintiffs said, in entire accordance with the contract. On June 8th notice was given by the defendants, purporting to be under the terms of the contract, calling upon the plaintiffs to execute certain works and remedy certain alleged defects within a limited time. Plaintiffs wholly denied that there was any default or defects, but on June 22nd a further notice was served upon them by defendants claiming and stating their intention to take immediate possession of the works; in short, to turn out the plaintiffs, who had large plant on the premises, and to prevent them altogether from completing the contract. Plaintiffs denied that they were at fault, and they were bringing forward a very considerable amount of evidence to show that the delay in building the works was entirely due to the defendants themselves.

Mr. WARMINGTON said the fact was that the contractors would not work according to the contract, and there had been delay so long that the Westminster Electrical Supply Corporation wanted these works completed.

Mr. JUSTICE KEKEWICH pointed out that to make another contract to bring new plant on the premises would take time.

Mr. BUTCHER said there could be no object on the part of a big firm like the plaintiffs in delaying the construction, and, in fact, they wish to build as quickly as possible. As late as April last, defendants gave them notice to complete the works by September 29th, and they were quite willing, and quite able, to do so, but notwithstanding that defendants now desired to turn them out on the spot.

Mr. JUSTICE KEKEWICH: What are you prepared to do?

Mr. BUTCHER: We are prepared to go on with the works according to the specifications and drawings, and any further specifications and drawings that the contract provides for, with the utmost diligence, and to carry out to the best of our ability the contract, and to proceed with due diligence with the works under the contract. Our only desire is to go on with the contract and complete the works, and I should be perfectly willing to give an undertaking to that effect.

Mr. WARMINGTON: The fact is, my friend takes one view of the contract and we take another. The architect is by the contract to be the sole judge. They have quarrelled with the architect and that is the trouble.

After consultation between counsel it was arranged that the motion should stand over on undertakings, with liberty to apply.

BUSINESS NOTICES &c.

Electrical Wares Exported.

WEEK ENDING JULY 12TH, 1897.	£	s.
Albany	43	0
Alexandria. Teleph. mat.	103	0
Amsterdam	50	0
Autofagasta. Teleg. mat.	53	0
Bombay	45	0
Boulogne	118	0
Buenos Ayres	380	0
" " Teleg. mat.	135	0
Calcutta	297	0
Cape Town. Electric mining machinery	245	0
Cape Town. Teleg. mat.	2,521	0
Copenhagen	120	0
Durban	217	0
Fremantle	90	0
Gothenburg	30	0
Hamburg	53	0
Hong Kong	32	0
Liban	350	0
Melbourne. Teleg. mat.	148	0
Newcastle. Electric machinery... ...	2,078	0
Odessa. Teleg. mat. ...	77	0
Ostend	25	0
Port Elizabeth	398	0
" Said. Teleg. wire.	994	0
Rosario. Teleg. mat. ...	3?5	0
Rotterdam. Teleg. wire	63	0
St. Petersburg	122	0
" " Teleg. wire	888	0
Santos	77	0
Shanghai. Teleg. wire	872	0
" Teleg. cable	9,973	0
Stockholm	400	0
" Teleg. mat.	944	0
Sydney	307	0
Vera Cruz	24	0
Vigo. Teleg. mat. ...	50	0
Yokohama	450	0
Total	£23,164	0

WEEK ENDING JULY 12TH, 1898.	£	s.
Adelaide	142	0
Amsterdam	125	0
Antwerp	10	0
Bahia. Teleg. mat. ...	50	0
Bombay	3	0
Boulogne	90	0
Buenos Ayres. Teleg. mat.	450	0
Cape Town	165	0
Colombo...	210	0
Copenhagen. Teleg. cable	550	0
Demerara. Teleg. mat.	99	0
Durban	20	0
East London	188	0
Fremantle. Teleg. mat.	84	0
Gothenburg	189	0
Hamburg	60	0
Hiogo	119	0
Hong Kong	30	0
Liban	50	0
Lisbon. Teleg. cable ...	200	0
Melbourne. Teleg. mat.	29	0
Ostend	80	0
Perth	600	0
Port Elizabeth	191	0
" " Teleg. mat.	500	0
Santander	70	0
Shanghai. Teleg. mat.	300	0
Singapore. Teleg. mat.	22	0
Stockholm	12	0
" Teleg. mat.	215	0
Sydney	775	0
Total	£5,718	0

Foreign Goods Transhipped.

	£	s.
Wellington. Teleg. wire	15	0

Annual Outing.—On Saturday last, July 9th, the staff to the number of about 34 connected with the firm of Messrs. Ferranti, Limited, electrical engineers, Hollinwood; held their first annual picnic. The party, which was accompanied by the head of the firm, Mr. Ferranti, and also Messrs. Lawrie and Laws, started from the works at about 1 30 p.m. in waggonettes, and proceeded by way of Middleton and Barton over the Ship Canal bridge, then on to Urmston, where the party partook of dinner provided at the Nag's Head Hotel. After dinner Mr. Lawrie proposed the toast of "Success to the firm of Ferranti, Limited." In responding, Mr. Ferranti made a few appropriate remarks, and in addition said he hoped that this, the first annual picnic in connection with the firm, was only the forerunner of a long series of successful outings, and although a programme of songs, toasts, &c., had been drawn up, he thought that as it was such a lovely day, they could not do better than adopt Mr. Lawrie's suggestion, namely, to cancel the programme part of the business and get out into the open air. Mr. Muir then proposed the health of Mrs. Ferranti, to which Mr. Ferranti also suitably responded. The party afterwards dispersed, some going for a walk into the country, whilst others disported them-

selves on the bowling green adjoining the hotel. The Nag's Head Hotel was left about 9 o'clock, the party returning by way of Manchester to Hollinwood, after having spent a most enjoyable and glorious afternoon. We may add that the whole of the arrangements in connection with the picnic were ably carried out by Messrs. Muir and Hinchcliffe, to whom the greatest praise is due.

British Thomson-Houston Company, Limited.—Amongst a number of important orders recently received by the British Thomson-Houston Company, Limited, are the following:—Two complete electrical power plants for Messrs. Vickers, Sons and Maxim, Limited, one of 600 H.P., being for their Barrow works, and the other, of 400 H.P. for their Erith works; a 600-H.P. factory installation for Messrs. Lever Brothers, Limited, of "Sunlight Soap" fame; two large motor-alternator plants for the Newcastle-upon-Tyne Electric Supply Company, Limited; electric brake equipments for motor-car and trailer, and a special water-tank motor-car, for the Leeds City Tramways; two complete motor-car equipments for the Portrush Electric Tramway; 50 new car bodies for the Dublin United Tramways Company, Limited, and 20 additional complete motor-cars for the Bristol Tramways and Carriage Company, Limited. The British Thomson-Houston Company, Limited, have also secured a contract for the supply of a considerable quantity of steel rails, fish-plates, and accessories, and electrical rail-bonds, for the Brisbane Tramways Company, Limited.

Catalogues.—We have received a catalogue from Messrs. E. Goosens, Pope & Co., which illustrates and sets forth the details of their various lamps. The information given on the subject of high efficiency lamps is interesting, and should prove useful to the trade. It ought to be mentioned that this firm has opened London offices at 5, Guildhall Chambers, Basinghall Street, and is represented by Mr. M. W. O'Connell.

We have received a useful catalogue of carbons manufactured by Messrs. Schiff & Co., of Vienna, who are represented in this country by Messrs. Bergtheil & Young.

An Electrical Engineer Fatally Injured.—Mr. Basil Aylmer Clegg, 25 years of age, of Norman House, Bowdon, a young man of great promise, received injuries at the new goods station of the Great Northern Railway Company, Deansgate, Manchester, which resulted in his death on Tuesday, July 5th. The deceased had placed a ladder on the line and was attending to an electric lamp when a waggon was forced forward. It struck the ladder, and deceased fell to the ground. He never recovered consciousness. A verdict of accidental death was returned, and a rider added that the Railway Company had not taken sufficient precautions to provide for the safety of the men engaged at the lamp.

Electrical Engineering in Brazil.—A company has just been formed in Berlin with a capital of £250,000, to be known as Die Brazilianische Electricitäts Gesellschaft, to work an electric tramway, and also a telephone exchange in Rio de Janeiro. Messrs. Siemens & Halske, of Berlin, are interested in the new concern.

Electrical Engineering in Italy.—La Società Veneziana di Elettro-Chimica is the title of a company which has just been formed in Venice with a capital of £24,000, to acquire and utilise certain available water-power in Corinthia, and to establish works for the production of carbide of calcium.

Incandescent Electric Lamp Company, Limited.—We are informed that this company has now occupied the large extension of their factory, the building of which has become necessary owing to the increase in the demand for the "Robertson" high-voltage lamps. This extension will enable the company to meet the demand of the coming season for high-voltage lamps which present orders leads them to believe will be in excess of the past season.

Lithin.—We have before us from the Deutsche Kabelwerke vorm Hirschmann Co. Act. Ges. Rummelsberg bei Berlin, tests by the Physikalische Technische Reichsanstalt, and samples of their new insulating material, lithin, a species of hard rubber which can be used effectively for similar purposes to hard rubber and vulcanised fibre in the manufacture of dynamo motors, transformers, &c., both for low and high tension work. It is supplied in sheets, rods or tubes from ½ mm. up to any thickness. It is largely used in Germany by the Post Office and the leading electrical firms, such as Schuckerts, Siemens, Allgemeine, &c., generally for H.T. work. According to the tests it is not hygroscopic, immersion in water for 72 hours showing only 0·41 per cent. of a drop. Samples of both the red and black variety have been sent to us.

Messrs. Cordes & Co., Berlin.—Messrs. Cordes & Co., of 19, Elisabeth Ufer, Berlin, inform us through our representative that they are laying themselves out to manufacture to order, various descriptions of stampings in brass. They make a speciality of covers and coronae for arc lamps, either their own design or to the designs of customers. Our representative was shown samples of covers both in the rough and finished and enamelled. These were well and strongly made, and of elegant design; all joints were turned over and pressed, even where soldering would be permissible. The senior partner of the firm has spent some years in England, so that they are well up in English requirements.

Messrs. H. F. Joel and T. Potter & Sons, Limited.—The annual holiday of the employés of this company was held on Saturday last, when a most enjoyable day was spent at Egham. The dinner served at the Angler's Rest, at Bell Weir Lock, was excellent, and the amusements provided for the excursionists and their guests were varied and engrossing. Boating, cricket, swimming, running, and other sports were encouraged by the presentation, by the firm, of a number of prizes. We congratulate the head of the electrical department of the firm, Mr. Joel, on his success in winning the prizes offered for both bowling and batting in the cricket match.

Multipolar Machines.—We have received an excellent catalogue of multipolar continuous current dynamos and motors from Messrs. Easton, Anderson & Goolden, Limited. There is a considerable amount of detail concerning this class of machine, and the text is aided by some excellent illustrations.

The Supply of Electrical Energy.—The Report from the Joint Select Committee of the Houses of Lords and Commons on Electrical Energy (Generating Stations and Supply) was issued on Saturday in the form of a Blue-book. The following five questions were submitted to the Committee:—"1. Whether, notwithstanding the provisions of Section 12 (1) of the Electric Lighting Act, 1882, powers should be given in any cases for acquiring land compulsorily for generating stations; and, if so, under what conditions as respects liability for nuisance, notices to surrounding owners, and otherwise; (2) Whether compulsory powers of acquiring land for generating stations, if proper to be given in any case, should be given where the proposed site is not within the area of supply. 3. Whether, in case of a generating station, however acquired, not being situate within the area of supply, power should be given for the breaking up of streets between the generating station and the boundary of the area of supply. 4. Whether powers should be given in any case for the supply of electrical energy over an area including districts of numerous local authorities involving plant of exceptional dimensions and high voltage, and, if such powers may properly be given, whether any, and what, conditions should be imposed—(*a*) With respect to system and plant, and to the construction and location of generating stations, in view of the powers of purchase conferred upon local authorities by Sections 2 and 3 of the Electric Lighting Act, 1888. (*b*) With respect to the relations of the promoters to other undertakers and to local authorities within parts of the area; 5. Under what conditions (if any) ought powers to be conferred upon promoters seeking to supply electrical energy to other undertakers and not directly to consumers." The committee say with regard to the first question that the proved public advantages of electrical energy in the generation of light and power warrant, in their opinion, the granting to undertakers of compulsory powers for acquiring sites for generating stations and lands or easements for pipes and mains therefrom, and other works. The powers should be granted on provisional orders, procedure by private Bill being reserved, as at present, for exceptional cases. As to liability for nuisance where the site is acquired under compulsory powers, the committee think the undertakers should not be subject to further liability than that which is imposed by the common law in the case of persons exercising statutory powers and duties; and where the site is acquired by agreement the undertakers ought to be subject to the same liability. They suggest no alterations as to the notices to be given. On the second point, the committee are of opinion that compulsory powers for the acquisition of land for a generating station, and lands or easements for pipes, mains, and other works to the area of supply, may also properly be given where the proposed site is not within the area of supply. As to the third question, the report recommends that in the case of powers being given for the erection of a generating station outside the area of supply that powers may be given for laying the mains in streets leading from the generating station to the boundaries of the area of supply, the local authority liable to maintain the streets having the option of breaking up and reinstating the streets at the undertakers' expense. While it may be advisable to maintain the veto of local authorities as to the erection of overhead wires, it is not advisable that, in the case of overhead wires for traction purposes, the local authority, other than the London County Council and County Boroughs should have an absolute veto. Dealing with the fourth and fifth questions, the committee observe that where sufficient public advantage is shown powers may be given for the supply of electrical energy over an area, including districts of numerous local authorities, and involving plant of exceptional dimensions and high voltage. With regard to giving compulsory powers of purchase the Committee think the provisions of the Electric Lighting Act, 1888, enabling the local authority to purchase an undertaking after a term of years, inapplicable, as a general rule, to the case of an undertaker supplying energy in bulk at high voltage, but there may be special cases where it is desirable that the local authorities should have the right to purchase reserved to them. To meet such cases they suggest that the Board of Trade should have power to insert the purchase clause in the provisional order, if the local authorities concerned can, in the opinion of the Board, show good cause for such a course. In cases of the exemption from liability to purchase, it would be specially expedient in the interest of the consumers that some kind of sliding scale, as in the case of gas undertakings, should be imposed. The committee report against the consent of the local authority continuing to be a condition precedent to the granting of a provisional order, and suggest that the local authority instead should be entitled to be heard before the Board of Trade. They are of opinion that local authorities should be empowered to purchase undertakings partly outside their source of supply. As compulsory powers are given solely for the benefit of the public, the committee think it would be desirable to make some provision against these companies being subject to foreclosure on mortgage and against their rolling stock and plant being liable to distress.

Switch Fuses.—From Messrs. John Fowler & Co. we have received lists of the Hall & Fuller high and low-pressure switch fuses, the chief novelty in these being in the coating of the high tension fuses with asbestos braiding, which most efficiently damps and extinguishes an electric arc of 2,000 volts.

Winchester.—With the opening of the Winchester Electric Light Works has come the establishment of a number of electric fittings agents in the city. Messrs. E. W. Gudgeon & Co., of Finsbury Pavement, London, have opened a branch at Messrs. Gudgeon & Sons, the Piazza, and are at present engaged in fitting up a large restaurant which is about to be opened in the High Street. Mr. E. T. Fiford, electrical agent of Southampton, has opened a branch in the square, and Messrs. Dicks & Sons, who are the sole agents for the Welsbach Incandescent Gas Lighting, have opened a department for electric lighting; and have already fitted up two or three establishments.

ELECTRIC LIGHTING NOTES.

Armagh.—The first real installation of electric lighting in the city of Armagh has been the erecting of electric plant, &c., at the new buildings at the County Asylum, Armagh. The buildings are lit entirely with electricity, and are at present under the supervision of Mr. H. Censer, electrical engineer.

Ashford.—With a view to effectively oppose electric lighting companies, the District Council has resolved to apply for a provisional order.

Bedford.—Considerable extension has been made in street lighting by the Corporation.

Bexley.—Messrs. Dolman, Pritchard & Co. have written to the Bexley Rural District Council, announcing their intention to apply for powers to supply the district, including Bexley, Erith, Dartford, and Gravesend, with electricity.

Blackpool.—At the meeting of the Town Council last week letters were submitted from the Local Government Board consenting to the adoption of the overhead trolley system of electric traction on the Corporation tramways, and as to the Department's sanction to the borrowing by the Corporation of an additional £40,000 for electric lighting extension in the borough. Councillor Brodie, who moved the adoption of the proceedings of the Electric Lighting and Tramways Committee, said that in addition to the £40,000, sanction had been obtained for the borrowing of a further sum of £9,400, which was applied for at the same time. They had already spent £4,000 on motors and other things, so that whatever system was adopted, this amount of money had been expended. In answer to a question, he said they were not adopting any system at present, and the Committee were determined to have the whole scheme before them shortly with explanations from the engineer.

Bolton.—The Bolton Town Council last week approved of the recommendations of the electrical engineer (Mr. Arthur Ellis) for extensions of the electric lighting plant and a change from the present alternating current to the continuous current for the central part of the town. The cost for extensions on the alternating current principle was estimated at £16,830, and for the introduction of the continuous current the engineer says £21,576 is required. He adds, however, that it must be noted that the estimate for continuous current includes two 600-kw. sets, as against only one 600-kw. set in the estimate for alternating current, thus making a difference of £7,000. The reason for allowing for two sets of continuous current plant is on account of spare plant, whereas with the alternating current the present plant will be spare for the large set. Furthermore, as regards mains, the estimate for continuous current included the cost of increasing the capacity of the feeders to 1,200 kw., as against 1,000 kw. in the estimate for alternating current. Consequently, the continuous current was lower than for the alternating.

Bournemouth.—At Bournemouth Town Council on Wednesday (July 6th), the following electrical matters were dealt with. The Joint Pier, Winter Gardens and Parks Committee reported as follows:—Electric Lighting Contract, No. 1.—The following tenders were received for the installations at the Pier, the Pleasure Grounds, and the Winter Gardens, together with switchboards, fittings, instruments, and other items:—The Walsall Electrical Company, Limited, £2,695 16s. 6d.; Leonard G. Tate, £2,997; Siemens Bros. & Co., Limited, £2,192; Crompton & Co., Limited, £2,097; Johnson & Phillips, £2,083 1s. 6d.; Brush Electrical Engineering Company, £1,598; R. Algar & Sons, £1,867 8s. 11d.; Cash Robinson & Co., £1,784 1s. 4d. An informal tender was also received. Recommended that consideration be deferred, and the surveyor instructed to report on the tenders after consultation with an electrical expert. Electrical Lighting Contract, No. 2.—The following tenders were received for the supply of steam dynamo, &c.:—The United Ordnance and Engineering Company, £1,125; ditto (alternative), £1,253; J. H. Holmes & Co., £1,090; ditto (alternative), £1,420; ditto (alternative), £1,270; the Electric Construction Company, Limited, £1,458; ditto (alternative), £1,261; ditto (alternative), £1,209; Crompton & Co., £1,126; ditto (alternative), £969; ditto (alternative), £825; Johnson & Phillips, £1,215; ditto (alternative), £1,325; ditto (alternative), £1,150; ditto (alternative), £1,080; Brush Electrical Engineering Company, £1,367 10s.; Leonard G. Tate, £1,565; Siemens Bros. & Co., Limited, £1,135; ditto (alternative), £1,085; R. Algar & Sons, £1,425; ditto (alternative), £1,337. Consideration was also deferred. Electric Light Pillars:—The following tenders were received for the supply of (*a*) nine cast-iron ornamental lamp pillars, (*b*) 10 ditto with special flanges, (*c*) 19 ornamental carriers for arc lamps, J. Allen, Sen., & Son; (*a*) £18 15s. each, (*b*) £18 5s. each, (*c*) £7 each; Geo. Smith & Co. (*a*) £12 5s. each, (*b*) £12 5s. each, (*c*) £5 10s. each; W. Macfarlane & Co. (*a*) £10 4s. each, (*b*) £12 18s. each, (*c*) £7 16s. Consideration was deferred. Loans:—A letter from the secretary of the Local Government Board was read, stating that the Board would not be prepared to further consider the applications for sanction to borrow £1,600 and £900 until the Council had decided whether or not they could generate their own electricity.—Recommended, that the town clerk be instructed to inform the Board the present position of the matter. Provisional Order:—The town clerk was instructed to report as to the steps to be taken to obtain a provisional order.—The report was adopted.

Bray.—A recent proposal made by a member of commissioners that the price of electricity be reduced to 4d. has been negatived, the former resolution adopting Mr. Harris's recommendation of a sliding scale benefiting the long hour consumer therefore stands.

Brierley Hill.—The District Council have resolved to oppose the application of the Midland Electrical Corporation for a provisional order.

Brighton.—At the usual meeting of the Brighton Town Council on Thursday, Councillor Galliers, in moving the adoption of the Lighting Committee's report, said they had tried to find the best reflector for the electric lamps, and recommended one which their men at the electricity works could make for about 6s. each. They thought it advisable to spend £282 in putting in a radiator in connection with the old chimney shaft. It would save the shaft from the tremendous heat, which had caused it to crack. Adopted.

Bristol.—Messrs. Read & Jenkins, of All Saints Chambers, High Street, have just completed a large extension of lighting at Messrs. H. Asham & Co.'s leather warehouse. The same firm have been successful in securing the contract for installing the electric light in the residence of Walter Verrier, Esq, Redland Estate, which work is in course of completion. Messrs. Read & Jenkins have opened an attractive showroom and offices in Gloucester in anticipation of the Corporation central station being completed, and current being supplied for public and private use.

Cardiff.—At the meeting of the Council last week, Mr. Appelbee, the engineer, produced figures, which showed that the expenditure for the six months ending March 31st, 1899, would be something like £2,581 7s., but to this must be added loan charges to the amount of £1,297 4s. 8d., making a total of £3,878 11s. 8d. The receipts, however, were estimated to produce £4,376, leaving a credit balance of £497 8s. 4d.

Coventry.—Interesting particulars of the financial working of the electricity department of the Coventry Corporation are afforded in the statement of accounts which has just been submitted to the City Council, with other financial information. The revenue account for the past year, ending December 31st, shows on the debit side:—To generation of electricity, £1,166 6s. 3d., viz.—coals and other fuel, including dues, carriage, unloading, storing, and all expenses of placing the same on the works, £314 0s. 3½d.; oil, waste, water, and engine room stores, £142 13s. 0½d.; salaries and wages at generating stations, £627 6s. 8d.; repairs and maintenance (buildings, £1 2s. 2d.; engines, boilers, £81 9s. 11d.; dynamos, exciters, transformers, motors, &c., £3 19s. 3d.; other machinery, instruments and tools, £5 1s. 8d.) £91 13s., less £9 6s. 9d. received for old materials. To distribution of electricity, £108 16s. 5d., viz, wages and other remuneration to linesmen, fitters, and labourers, £20 6s. 5d.; repairs, maintenance, and renewals of mains of all classes, including materials and laying the same, £80 13s. 6d.; repairs, maintenance, and renewals of tranformers, meters, switches, fuses, and other apparatus on consumers' premises, together with cost of materials and lamps sold, as per contra, £6 18s. 5d.; repairs, maintenance, and renewals of apparatus at distributing stations, 18s. 1d. To rates and taxes, £83 0s. 2d. To management expenses, £457 15s. 7½d., viz., salaries, engineers' department, £273 12s; accountant and clerical staff, £60 10s.; salaries or commissions of collectors, £19 5s. 9d,; stationery and printing, £28 18s. 11d.; general establishment charges, £75 8s. 11½d.; to special charges, insurance, £36 18s. 6d. The total expenditure was £1,852 16s. 11½d. and the total income £1,958 19s. 8d., leaving £106 2s. 8½d. to carry to net revenue account. The details of the income were as follows:—By sale of current per meter at 6d. per B.T.U., £1,915 9s.; rental of meters and other apparatus on consumers' premises, £43 10s. 8d. The quantity of current generated (in B.T. units) was 128,845; sold, 79,583; used on works, 9,878; copper losses, 5,000; used in magnetising transformers, 34,384; total maximum supply demanded 126 kw.

Clacton-on-Sea.—The Urban Electricity Supply Company, Limited, are about to apply for a provisional order for electric lighting in the Clacton Urban District Council's district, and also for confirmation by Parliament in the Session 1899.

Croydon.—The great success of the electric light installation in Croydon has led the Corporation to undertake a considerable extension of the supply. In all parts of the borough where the electric light mains have already been laid, traders and private residents, especially the former, have taken it up with the greatest possible appreciation. Now the system is to be extended to South and Upper Norwood, and on Monday Col. Langton Coke, of the Local Government Board, held an inquiry at the Croydon Town Hall into an application by the Corporation for leave to borrow £23,278 for this extension. The success of the installation in Croydon, although it is so short a time since electricity was adopted, has far exceeded the expectation of the Corporation, and it is now almost certain that electric haulage will be adopted for the trams.

Devonport.—The Devonport Borough Council at their last meeting had before them the Electric Lighting Committee's minutes, which stated that Prof. Kennedy's report on the proposed electric light and power station had been received, and that the town clerk had been requested to inquire whether Lord St. Levan, the lord of the manor, was disposed to sell some land on the west side of Richmond Walk for an electric light station. The town clerk informed the Council that Lord St. Levan was unwilling to sell the land referred to.

Dudley.—A communication has been received from the Board of Trade informing the Dudley Town Council that Dudley has been omitted from the area to be supplied by the Midland Electrical Corporation.

Dundee.—Street lighting is to be extended by the addition of 27 lamps, which will cost £838.

Durham.—The question of electric lighting was under discussion at a recent meeting of the City Council. The clerk read letters received from the Urban Electrical Supply Company, and from the Electrical Power Distribution Company, Limited, intimating that they were making application to the Board of Trade for a provisional order. After discussion, it was decided that a committee be appointed to gather information on the subject, to obtain estimates, and so forth. There was a general expression of opinion in favour of an electrical supply, and no doubt the Council will decide to support the application of one of the companies mentioned for the granting of a provisional order.

Edinburgh.—Considerable extensions, involving £1,600 are to be made.

Eton.—Notice has been given to the District Council that a company is to apply for powers to supply electricity in Farnham Royal, Stoke Poges, Datchett, Slough, Upton-cum-Chalvey, and Eton.

Farnham.—Notice has been given to the District Council by a company of intention to apply for lighting powers.

Felixstowe.—The Felixstowe and Walton District Council having received intimation of the intention of the Coast Development Company to apply for a provisional order to supply electricity for public and private purposes at Felixstowe, a long discussion took place at the meeting of the Council on Wednesday, at which it was stated that whilst the gas company charged 5s. per 1,000 feet, they would be enabled to get the electric light at a cost equivalent to 3s. 6d. per 1,000 feet of gas. The following resolution was passed: "That it be referred to the General Purposes Committee to consider and report upon the desirability or otherwise of the Council undertaking the supply of electricity for public and private purposes."

Fermoy.—This town is in a fair way to have the electric light, for an agreement between the local authority and a local company has been made.

Frimley.—The Electric Works Company, Limited, has given notice to apply for powers.

Gas and Electric Light at Aberystwith.—At a meeting of the Aberystwith Public Library Committee the question of the lighting economy has just come up for discussion. On a question by Archdeacon Protheroe as to the relative cost of electricity and gas, Mr. C. M. Williams, the chairman, said it would be very difficult at present to reply. He assumed it was about the same. The electric light had a great advantage over gas owing to the fact that the rooms were not so hot, and whereas gas-light damaged the books in the upper shelves, the electric light left them in better condition.—Capt. Doughton said there had been a big escape of gas during the last quarter, and for some time it could not be traced.—The Chairman: Yes, the gas bill for the last quarter was very heavy. Both gentlemen concurred that the bill for lighting would be less in future.

Hammersmith.—At the weekly meeting on Tuesday of the London County Council, the Finance Committee reported having received an application from the Vestry of Hammersmith for the loan of £31,000 for electric lighting. A loan of £38,935 has already been granted by the Council, and the Vestry now asked for a further advance of £3,500 for additional expenditure on the original contracts, £24,500 for additional plant and extension of mains, and £3,000 for new buildings, one-half to be advanced immediately, and the second half on January 1st next, repayable by the instalment system in 42 years. The Council's engineer reported that he had not yet received particulars of the full expenditure, but those which had been furnished enabled him to recommend that sanction be given to the advance of the £15,500 now proposed to be taken up on the engineering works alone, leaving the matter to be finally dealt with when the second half of the amount required is applied for. On the recommendation of the Committee the Council decided to lend the Vestry £15,500 at 3 per cent. The same Committee announced the receipt of an application from the Vestry of Hampstead for the loan of £17,700 for additional electric lighting plant at the station at Lithos Road, repayable by annual instalments in 42 years. The Council's engineer reported that this application was based upon the Vestry's estimate of the probable cost of the work; that some of the prices were high, but might be justified when fuller particulars of the works are supplied, and he suggested that the loan, less £1,000, might be now advanced, leaving the balance to be re-applied for when the contracts had been completed. The Council's architect had examined the drawings and prices for construction of the foundations, &c., for the engines, and the cost, £1,200, appeared to be reasonable. The Committee accordingly recommended, and the Council decided, to lend the Vestry £16,700 at 3 per cent.

Heckmondwike.—At their meeting on Monday evening, the Heckmondwike District Council had before them letters from Messrs. Foote & Milne, and the Electric Current Distribution Company with respect to the lighting of the town by electricity and the supply to shopkeepers. It was decided to give Messrs. Foote and Milne's representative an interview at an early date, and to take preliminary steps for preventing the revocation of the Council's electric lighting provisional order by allowing private enterprise to step in. The Council some time ago obtained an order enabling them to supply electricity in the town, but no steps have yet been taken in the matter. It is probable that the Council will put down a small installation to protect themselves.

The Heckmondwike Co-operative Society are about to put in an electric lighting installation at their central stores. The plans have been prepared by Mr. Leake, consulting electrical engineer, of Manchester, and tenders have been invited. No less than 40 have been received from all parts of the country.

Hereford.—The Corporation Electric Lighting Committee, which has been visiting several metropolitan electricity works, has recommended the Town Council to apply for powers to borrow the necessary money to purchase a site for works. The recommendation has been adopted.

Horsham.—At the meeting of the Horsham District Council on Friday the report of the Electric Lighting Committee, recommending that application be made to the Board of Trade for a license authorising the Council to obtain a supply of electricity in the urban district was considered. Mr. W. C. C. Hawtayne, who had been consulted, advised that certain streets named should be scheduled in the compulsory area, adding that other portions of the town might easily be connected with the supply mains from the extremities of these lines and materially increase the revenue of the undertaking. The cost of the undertaking was estimated at £13,500, and the gross revenue at £2,116 13s. 4d. This was on the assumption that the public paid nothing more to the electricity supply works for the enormously improved lighting than they paid for gas lighting already. The total annual output would be 89,000 Board of Trade units. The total cost of production would not be more than at the rate of 3d. per unit, making ample allowance for maintenance of plant, &c. The principal item in cost of production was labour and supervision, which would remain practically the same when the works were supplying two or three times the above output. The profit and loss account would come out as follows:—Gross revenue, £2,116 13s. 6d.; works' costs, £1,112 10s.; gross profits, £1,004 3s.; repayment of capital and interest at 5¼ per cent. on £13,500, £702 10s.; net profit, £261 13s. 4d. At the end of the period of 25 to 30 years, when the loan was all repaid, the Council would have to its credit annually the whole of the gross profit on the works. From the above report the Council would see that there was no doubt as to the profitable nature of the undertaking, and Mr. Hawtayne thought they would do well to complete the works with all reasonable dispatch, securing to the ratepayers the future control of the public lighting of the town as well as the profits from the general sale of electricity. It was arranged that a special meeting should be called, at which a resolution will be proposed in favour of making application for a license or provisional order. In reply to questions, Mr. Hawtayne stated that a license could be got by November or December.

The Horsham Urban Council, at its meeting last week, adopted a report of the committee recommending an application to the Board of Trade for a license to supply electricity within the urban district at an estimated cost of a little over £10,000.

Lambeth.—The Vestry have received a letter from Messrs. Fladgate & Co., enclosing notice of the intention of the County of London and Brush Provincial Electric Lighting Company to apply for a provisional order to supply so much of Lambeth as lies to the north of Westminster Bridge Road with electrical energy for lighting and other purposes. On behalf of the same company, Mr. S. Morse has served notice of intention to apply for a provisional order for the purpose of taking mains through Lambeth, so as to connect the detached portion of Wandsworth district with the main portion.

Lancaster.—The Vicar of Lancaster (Rev. W. Bonsey), has received an estimate of the cost of lighting the old parish church of St. Mary's, at Lancaster, with electricity. The total cost will exceed £400, and of this about £330 has been subscribed. It is expected that the work will be completed in about two months.

Leatherhead.—The District Council's Bill for electric lighting has received Royal assent, and it is being practically offered at a price to the local gas company.

Leeds.—At the usual monthly meeting of the Leeds County Council on 4th inst., some serious reflections were cast upon the Yorkshire House-to-House Electricity Company who, it was alleged, were laying down "miles of mains." The public demand, said certain Councillors, did not warrant this, but they inferred that the House-to-House Company were "rushing" the assets of their undertaking in view of the forthcoming transference to the Leeds Corporation. These reflections have brought a strong denial from Mr. Grosvenor Talbot, chairman of the company, who asserts that the great increase of mains is strictly in accordance with the requirements of their customers. The company had not incurred a penny of expense which would not have been spent had the question of purchase by the Corporation never been mentioned.

It appears that the number of installations has increased 40 per cent. during the past 12 months, and the directors anticipate a reduction of prices in the course of a few months.

Lewisham.—The Great Western Electric Light and Power Company, Limited, and the County of London and Brush Provincial Electric Light Company have notified the Lewisham District Board of Works of their intention of applying for a provisional order to supply electricity within the district.

Londonderry.—The proposal of the new company formed some time ago in London in connection with the electric light, power, and traction business came before the Derry Corporation at the monthly meeting of that body held on Thursday, the 7th inst. The proposal of the company, writes a correspondent, is that they take over the electric plant and machinery, at present the property of the Corporation, for a sum of £16,000. The electric lighting of the city was first introduced about four years ago at a cost of £20,000, but although the then Corporation adopted the scheme believing it would effect a considerable annual saving of the rates as compared with gas, it has since turned out a white elephant, and it is calculated that it is at present being run at a loss of from £1,800 to £2,000 per annum. In a letter which he has addressed to the press, and a copy of which he has sent to every householder in the city, Dr. R. H. Todd, solicitor, Derry—the advocate of the new company—asks the "support and influence of the citizens in securing the vast advantage of cheap light and power, and of an extensive system of electric tramways." He contends that the plant and machinery at present in use at the electric light station is depreciating in value at the rate of £1,000 per annum, that in 20 years it will be valueless, and thus a loss of £20,000 will have been sustained by the ratepayers at the end of that term; that taken in conjunction with the fact that the citizens are losing about £2,000 a year by electric lighting of the city, the total loss at the end of 20 years will amount to £60,000. The company's intention is to invest from £150,000 to £200,000 in extending and developing electricity in the city. This would include a private lighting scheme, and the working of an extended tramway system by electric power. If, in order to make the electric lighting of the city a paying concern, it will be necessary to expend such a large sum of money, then the Corporation might as well make up their minds to part with the property, as their borrowing powers are at present limited. This is the view of many of the citizens, and the decision of the Corporation at their meeting not to entertain the proposals has created much surprise. The proceedings at the meeting were of the liveliest character, and there were a number of exciting scenes witnessed. In the course of the discussion—and just when the excitement was greatest—Councillor McCarter, the most humorous—as he is admittedly one of the ablest—members of the board, produced a large blackthorn stick, which he said belonged to Councillor Bigger, and asked the Mayor to take charge of it till the meeting would come to an end. After a sitting extending over three hours, the Council decided, by a majority of 26 to 8, not to entertain the company's proposals. It is just possible, however, that at some future date the Corporation may decide on handing the business over to some private company, because, although voting against the company's proposals at this meeting, a large number are of opinion that if the Corporation put the electric lighting system on the lines proposed by this company they would command even better terms than those now offered, and are consequently in favour of retaining the right of electric lighting for the present.

Ludlow.—The Town Council has decided to apply for a provisional order.

Luton.—After a protracted debate at the meeting of the Luton Town Council a week ago, the Electric Lighting Committee succeeded in carrying their scheme a step further by getting their report adopted. The report included the following:—"That Mr. Albion T. Snell, civil engineer, of Suffolk House, 5, Laurence Pountney Hill, Cannon Street, London, be appointed electrical engineer for the following purposes:—(*a*) To prepare all detailed plans, drawings, specifications, estimates and schedules for erecting and completing buildings, the purchase and fixing of engines and plant; the providing and laying of conduits, wires, and other apparatus for completing the installation of electric light. (*b*) To make and complete all detailed plans, drawings, estimates, specifications, and schedules for the use of the Board of Trade, the Local Government Board, and contractors for such installation. (*c*) To attend meetings of the committee or Town Council when desired; to attend the offices of the Board of Trade and Local Government Board, and all inquiries instituted or required by either of the two last-named Boards. (*d*) To superintend in all things the whole of the works necessary and proper for the thorough completion of the said installation, save and except the erection of the buildings, making of trenches for street mains, and the re-instatement of the paving, footways, and roads excavated for the purpose of laying such mains." The majority in favour of the committee's recommendation was surprisingly large. The criticism was severe, but the discussion was, on the whole, marked by an excellent tone. Those who ranged themselves as critics of the committee's proposals justified their position in the sense that they adduced arguments of a weighty character. The concensus of opinion was against undue haste, and now that the report has been adopted, the committee is pledged to proceed cautiously. The amended report of Mr. Snell, the expert, was submitted, and was as follows:—

Revenue with Public Lighting.

First year's consumption estimated at, say, 126,590 units, sold at an average price obtained of 5·23d.

The average lamp connection during the first year is estimated as follows:—

	£	s.	d.
Private Lighting—			
6,000 lamps of 8 C.P. each; say, 90,000 units at an average of 5·92d.	2,220	0	0
Public Lighting—			
Nine arc lamps consuming 6,750 units per annum, charged at, say, £13 7s. 6d. each, including trimming	120	7	6
Incandescent lamps equivalent of 100 of 8 C.P., consuming 9,715 units per annum, including renewals	140	12	2
Motors—			
Estimated at 14,500 units, at an average of 4d. ...	241	13	3
Heating—			
Estimated at 5,625 units at 1 5d.	35	3	1
Estimated as earned during first year's working ...	£2,757	16	0

Maintenance with Public Lighting.

For a consumption of 126,590 units sold.

Works Cost (generation and distribution):—			
1. Coal and other fuel, including cartage	£342	16	11
2. Oil, waste, water, and engine room stores ...	131	17	3
3. Wages of workmen	369	4	5
4. Repairs and maintenance of buildings, plant, machinery and instruments, mains, meters, fuses, &c.	105	9	10
	£949	8	5
General Costs—			
5. Rent, rates, and taxes	119	3	0
6. Management expenses: Salaries engineer's department, collector, clerical staff, accountant, stationery, printing, law charges, insurance, and general establishment charges	418	0	0
Total works and general costs ...	£1,516	11	5
Capital Charges—			
Interest and sinking fund, 6 per cent. on £16,000 averaged over the first year	960	0	0
Sum set aside for depreciation in the first year—2 per cent. on £16,000	320	0	0
Total cost of maintenance	£2,796	11	5
Revenue	2,757	16	0
Estimated deficit for first year	£38	15	5

There were some very interesting comparisons made during the debate of other towns, result being quoted against result. Coventry was named as a place where electric lighting was a failure, and against this Cheltenham was named as a place where the electric light had been up to the present a great success. In the end the Committee's report was agreed to by 15 votes to 7.

Morecambe.—The remaining engines, two large and one small, for the electric light works, have at last been delivered from Colchester. The contractor, says a correspondent, does not seem to be clear of trouble yet. On July 4th the men were unloading a transformer weighing 5 tons at the West View sub-station, the chain slipped, and the machine fell to the ground with a terrific crash, doing damage to the extent of £100. Heysham, the neighbour of Morecambe, wants more light, and are thinking about electricity. If the Morecambe Gas Company don't "light up" for them, they will go in for the electric light.

Neath.—The Town Council of Neath have received notice from the Electrical Power Distribution Company, Limited, of their intention to apply for a provisional order. The Town Council have decided to deal with the matter in committee. A similar notice has been served upon the Briton Ferry Urban District Council, who have notified their intention of opposing.

Oldham.—At the Council meeting last week, Alderman Gourlay, the chairman of the Lighting Committee, gave a summarised account of the work of this department. Below will be found full details:—

Oldham Electric Supply Works.

Statement showing comparative working since the commencement.

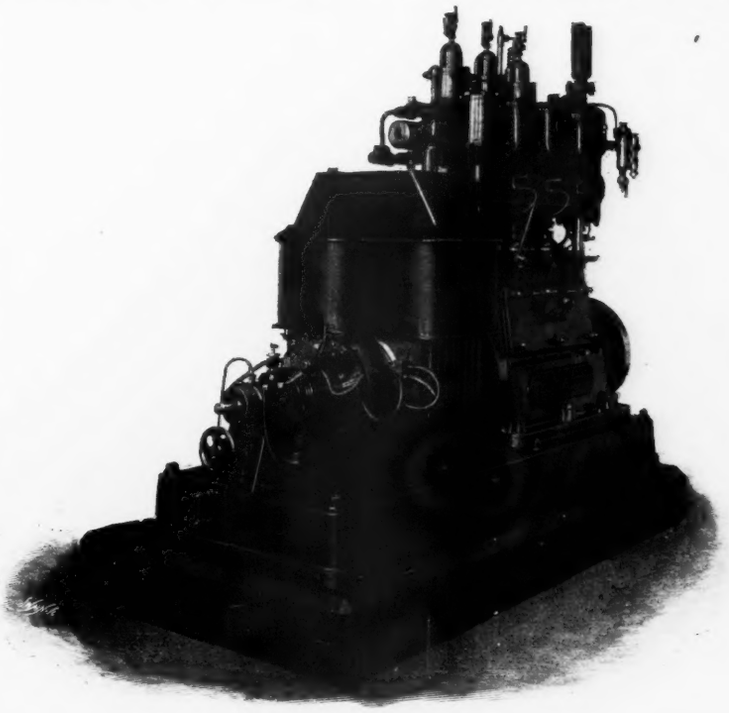
	1894-5. 1st year.	1895-6. 2nd year.	1896-7. 3rd year.	1897-8. 4th year.
Horse-power installed ...	320	720	720	1,080
Units sold ...	68,998	147,432	227,982	322,203
Price charged private ...	6d.	6d.	6d. and 4½d.	4½d. and 3½d.
Price charged public ...	6d.	6d.	4d.	3d.
Price obtained private ...	6d.	6d.	5·7d.	4·28d.
Gross profit ...	£644	£2,270	£2,946	£3,492
Net financial result ...	£152 loss	£848 profit	£1,043 profit	£1,351 profit
Total cost per unit ...	3·92d.	2·42d.	2·67d.	1·74d.

(*Continued on page* 90.)

MORLEY ELECTRIC LIGHTING WORKS.

The site of the Morley Corporation electricity works is on the west side of Corporation Street, between the new Public Baths and the Corporation depôt, and is situated in the centre of the town. The buildings, which were designed by the late borough surveyor, Mr. M. H. Sykes, are placed on the south side of the land reserved for the generating works, and are so arranged that a considerable area of land is reserved for future extensions.

The engine house is 40 feet wide × 68 ft. long, with switch room at one end elevated 3 ft. 4 in. above the floor, having an open front between it and the engine house. At a height of 20 feet above the floor an overhead travelling crane runs along steel rails the full length of the engine house. The room is excellently ventilated and lighted by means of ground clerestory windows, skylights and ventilators in roof. The test room is conveniently situated at the east side of switch room, the floors of which room are laid with wood block flooring.



Exciting Plant.

The accumulator room 40 feet by 12 feet 6 inches is placed over the switch and test room, and is approached by a staircase near the main entrance.

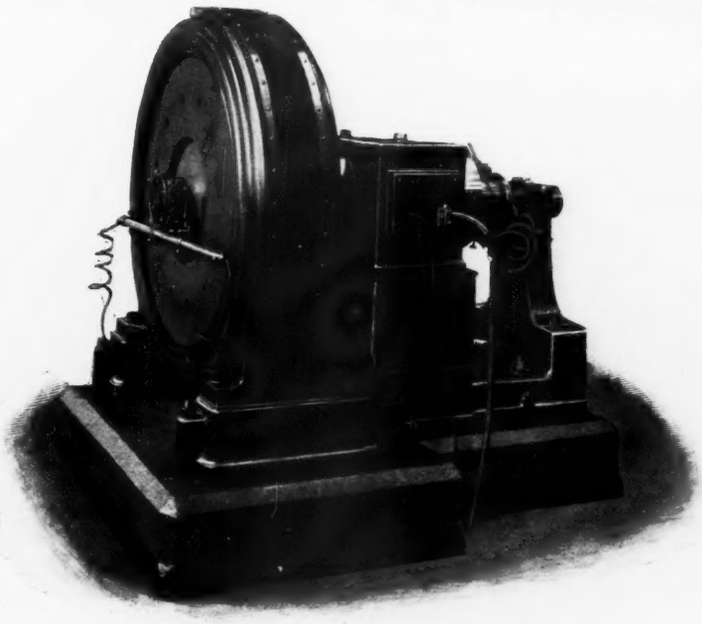
The boiler house is placed parallel with the engine house on the west side thereof, and is 68 feet long by 48 feet wide. Along the west side of the boiler house are placed the coal bunkers, 10 feet wide, and the pump room, 10 feet by 12 feet. At present there are two Lancashire boilers 30 feet by 8 feet diameter, and accommodation is provided for other two of equal size.

In the centre of the north end of boiler house is placed the chimney stack. It is 45 yards high and 14 feet square at its base, and 8½ feet square at the top.

One of Green's economisers, containing 96 tubes, is fixed between the boilers and chimney stack, and is so arranged as to be capable of enlargement as required when extensions are carried out.

The total cost of the buildings was £4,500.

In the boiler house there are at present erected, as we have said, two Lancashire boilers, 30 feet long by 8 feet diameter, each capable of evaporating 7,000 lbs. of water per hour at 125 lbs. per sq. inch, under a natural draught with the feed water at a temperature of 60° F. The boilers were made by Messrs. Holdsworth & Sons, of Bradford, and are fitted with Bennis mechanical stokers driven by an electric motor. The boilers are fed by a vertical double acting Worthington pump, working in conjunction with a "Korting" injector.



Motor Alternator.

Engine House.

The generating plant at present erected comprises the following:—Two sets of 125 kw. fly-wheel alternators, one motor alternator of 20 kilowatts, one direct current exciting plant of 30 kw. The whole of this plant has been laid down by the Electric Construction Company, the fly-wheel alternators being excellent specimens of modern electrical generating machinery. The two main engines are made by Messrs. Pollit & Wigzell, Limited, of Sowerby Bridge. They are of the horizontal compound non-condensing type, with cylinders 14 inches and 23½ inches diameter, 30 inches stroke, running at a speed of 100 revolutions per minute, with a working pressure of 130 lbs. per square inch. The cylinders are arranged side by side, the alternators being between the cylinders. Both the high and low pressure cylinders are fitted with Corliss valves actuated by the firm's patent automatic trip gear specially designed to suit high speeds. The steam valves on the high pressure cylinder are controlled by a spring governor of the Hartnell type, the low pressure cylinder has hand regulation to give a variable expansion. Both cylinders, and also the receiver pipe between the cylinders, are steam jacketed. The cranks are enclosed with neat planished steel casings to prevent oil being thrown off.

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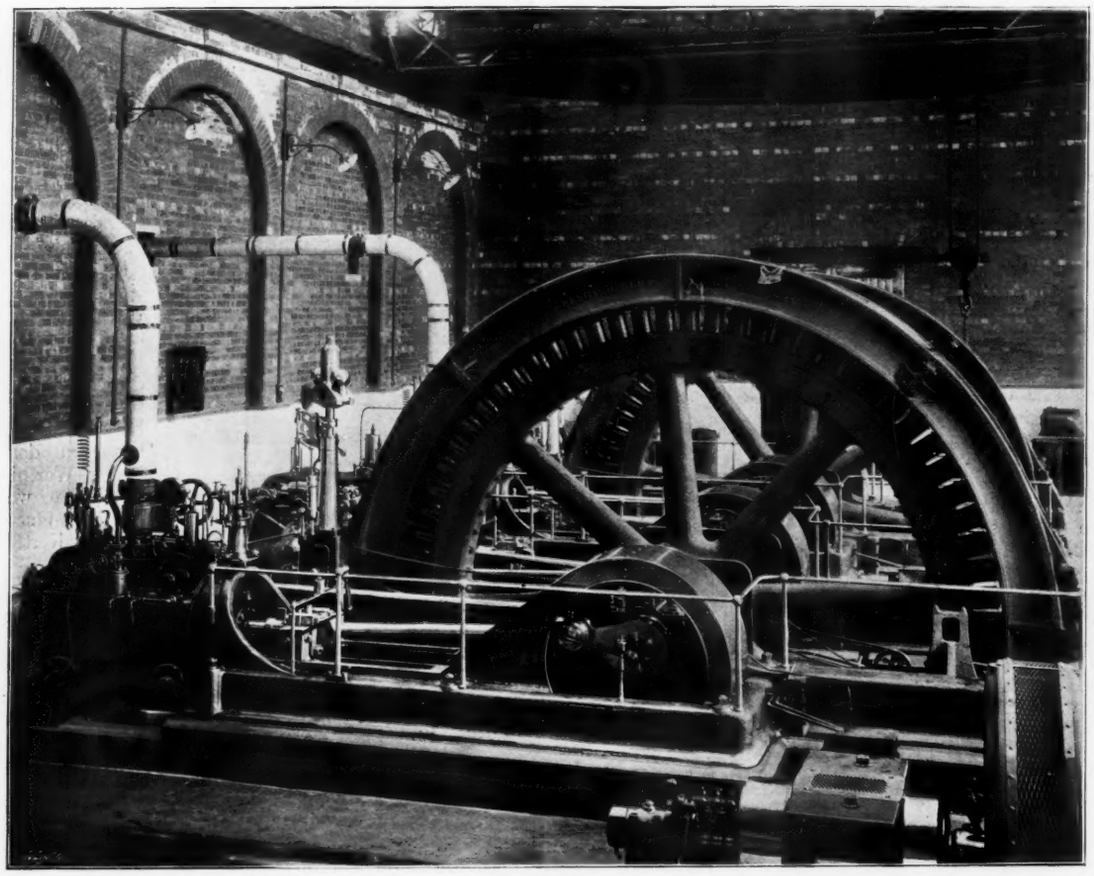
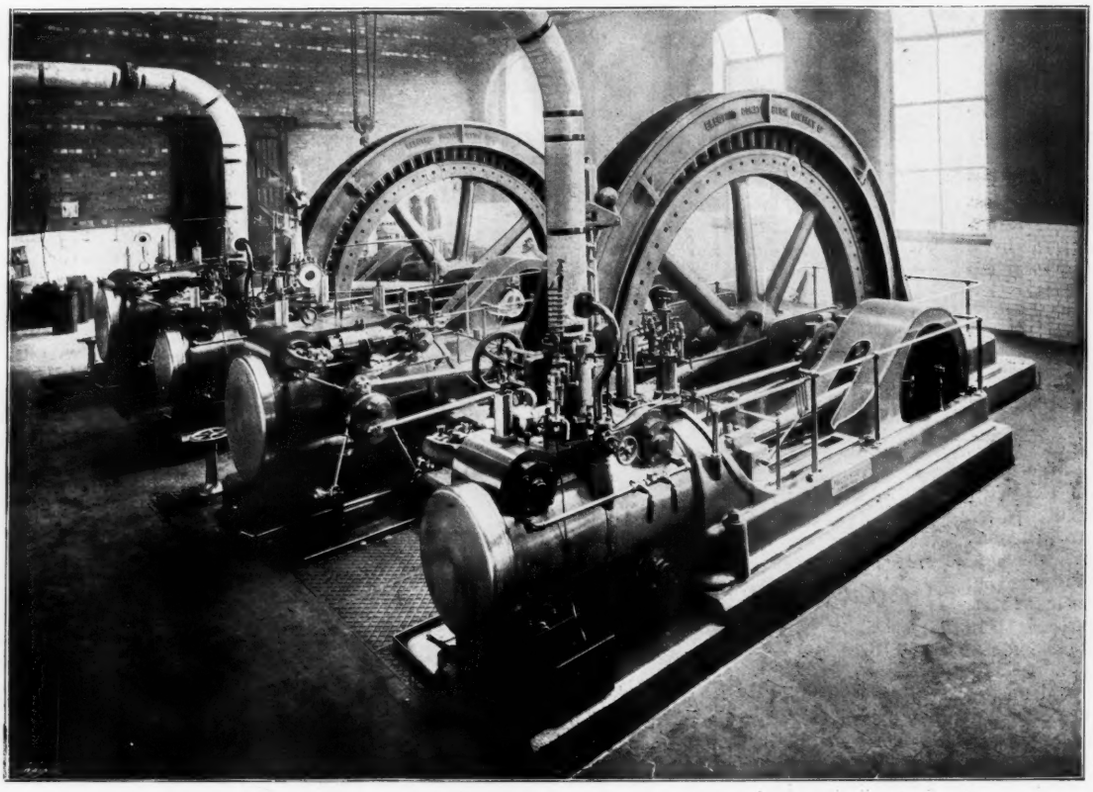
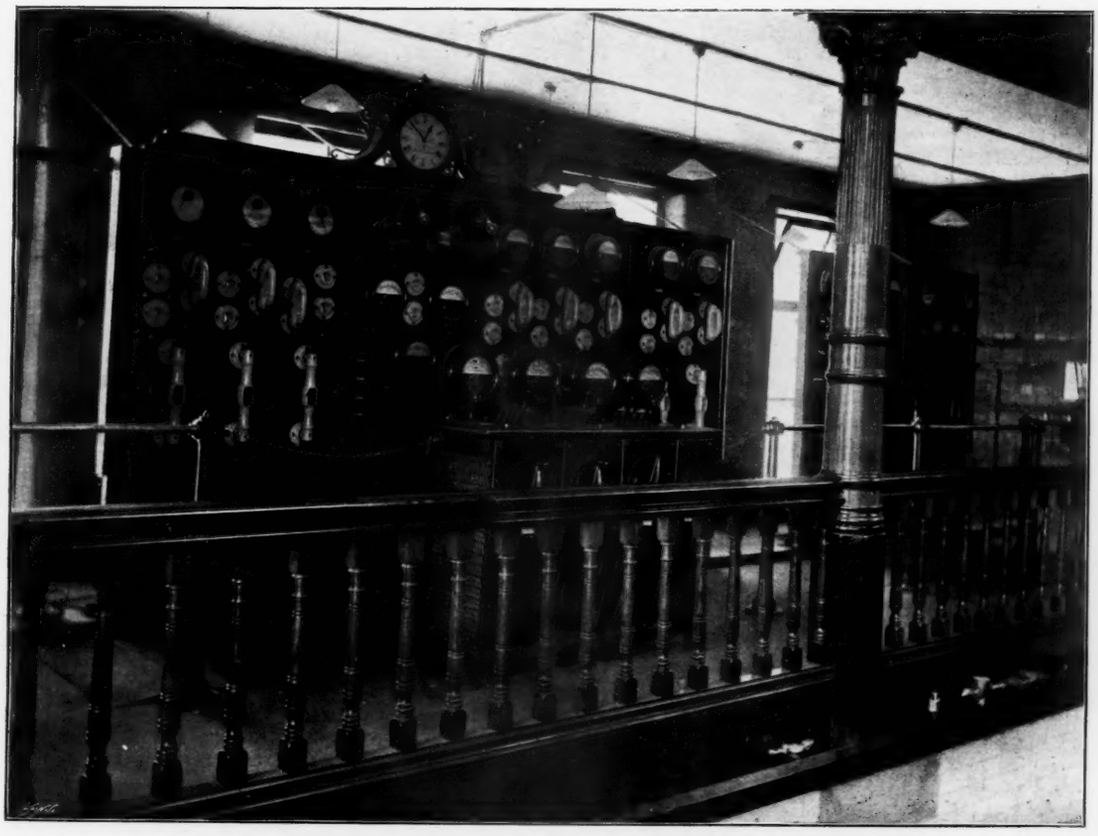


General View of Plant.



General View of Plant.

Views of Street Lamps.



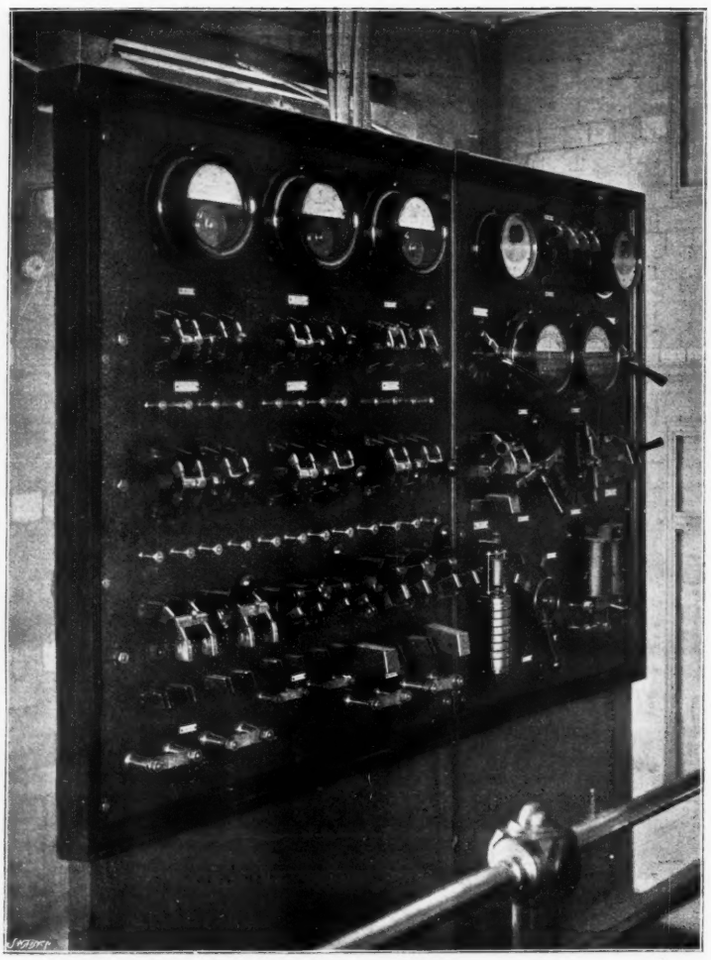
High Tension Switchboard.

The eccentrics are also guarded, so that no oil can get on the alternator. Special attention has been given to the continuous lubrication of the working parts, and all the waste oil from the crank and eccentric races passes into a tank at the side of the engine, and is pumped from there into filters to be used again.

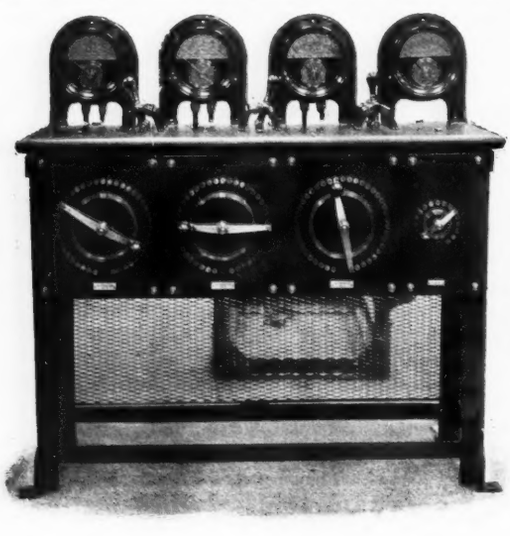
Messrs. Pollit and Wigzell have also erected the whole of the steam and water pipes in the engine and boiler house.

ALTERNATORS.

The two alternators are the well-known Construction Company's flywheel machines, each having a normal output of 125 kw. at 100 revolutions and an emergency output of 135 kw., the voltage being 2,000 to 2,200. The armature conductor is wound into special slots cut in the laminated charcoal-iron core in such a manner that, if necessary, a coil can be re-wound in about two hours. The core is composed of 36 separate segments, each consisting of a double coil, the laminated stampings being bolted to, and supported by, two cast-iron flange pieces, which latter are bolted to the massive cast-iron rings forming the framing. Each segment was tested with 6,000 volts between coil and frame and both machines were tested with a pressure of 4,000 volts, after running for 10 hours at full load. The field magnets consist of 72 steel poles, each wound with a separate magnetising coil, the poles are of circular cross section and are fitted into holes recessed in the rim of the cast-iron flywheel being securely held by steel bolts passing through the centres of the poles and the wheel rim.



LOW TENSION SWITCHBOARD.



REGULATING TABLE.

The fly-wheel is of cast-iron in halves, the half-centres being bolted together, while the rims are secured by shrinking on circular steel hoops let into circular recessed grooves so that the rings are flush with the wheel rim. The diameter over the poles is 13 feet, and the total weight of the wheel and magnets about 10 tons.

Each machine has a combined efficiency of 82 per cent. at full load, and over 83 per cent. at an over-load of 135 kw. The exciting energy at full load is 22 amperes at 86 volts. Under the specification it was provided that the temperature rise should not be more than 50° F., but the makers have managed to keep the temperature considerably below this limit. After a 10 hours' full load run the rise was under 40° F. on any part of the armature, and only 15° F. on the magnet coils.

The exciting current for the alternators is supplied by a separate direct current plant of 30 kw. capacity. It consists of an Electric Construction Company's standard bipolar type inverted continuous current dynamo direct coupled to a Peache high-speed engine, and mounted as usual on an extension of the engine bed. The armature is bar-wound, and is arranged to give the necessary extra volts for charging the battery of accumulators.

The motor alternator, which is to run the lights during the times of light load, has an output of 20 kilowatts, the speed being 600 revolutions per minute.

The alternator has a slot-wound armature, and is similar to the large machines, except that instead of being built in segments, the core stampings break joint, forming a continuous ring.

The continuous current portion of this apparatus is built precisely on the same lines as the exciter previously described, with the exception that it is of the standard E.C.C. upright type.

The whole of the steam pipes are made of lap welded steel, suitably arranged to allow for expansion. The pipes in the main range and branches to the boilers are 6 inches diameter, and the branches to the engines 5 inches diameter. A drain pocket is fixed at the end of the main range, and steam separators on the branches to each engine.

The exhaust steam is carried to the main exhaust pipe by a 12-inch pipe placed underground. A 3-inch pipe connects the engine drain to the sump.

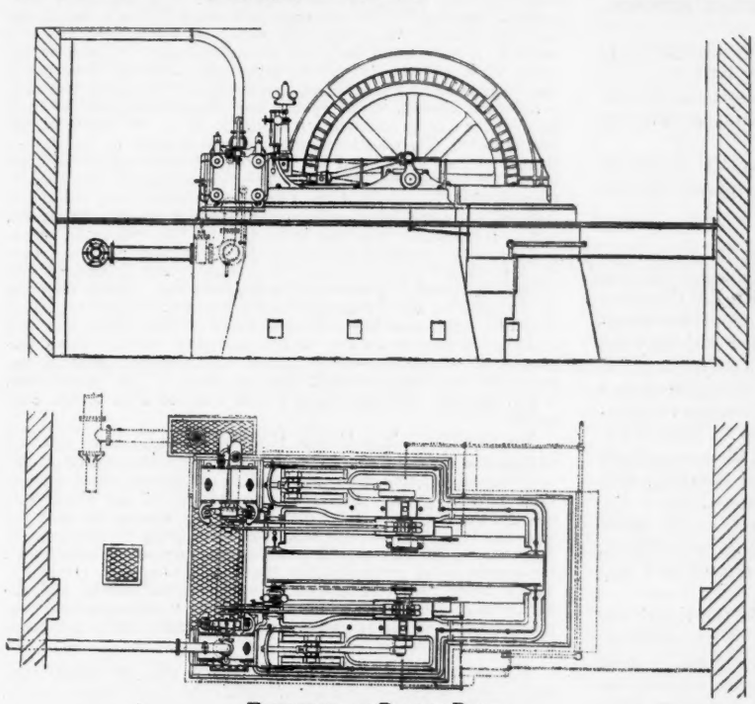
The feed pipes are erected in duplicate, a bye-pass to the

economiser being arranged on both pipes. A feed water tank, holding 3,000 gallons, has been placed underground.

The accumulators were supplied by the Chloride Electrical Storage Syndicate, and consist of 57 R type cells in glass boxes, capable of giving a discharge of 250 amperes for two hours, or 100 amperes for six hours, or 70 amperes for 10 hours, with a terminal E.M.F. of 100 volts. This battery can be used for supplying current to the motor-alternator, or for exciting both the alternators.

The switching and regulating arrangements at the generating station are divided into three sections as follows:—1. High tension switchboard for alternating circuits. 2. Low tension switchboard for exciter and battery circuits. 3. Regulating apparatus from which the field circuits of all machines are controlled.

The accompanying illustration shows the main high tension board with the regulating table in the front. The panel on the left hand contains switching gear for three alternators, each machine having one ammeter, two single pole switches of the plug type, and one fuse.



Elevation and Plan of Plant.

The machine switches are provided with guides additional to those for the contacts, so that the switches can be carried in the guides without making contact, and so can be placed in readiness for finally pushing home after synchronising. The fuse consists of a porcelain case with glass tube let into it, so that through an opening in the porcelain in the centre the condition of the fuse can be seen.

On the right is the circuit panel, exactly similar to the alternator panel, with the exception that the switches are not fitted with guides. Two bus bars are provided, and there are two switches on each alternator and feeder circuit, so that the machines or the feeders can be put on to either of the two bus bars.

The centre panel has mounted on it synchronising lamps and plugs, voltmeters with voltmeter switch, and also a plug switch, similar to the main switches for connecting bus bars.

The panels are of slate, and the framework carrying them is built up of steel angle and T irons, while the panels are surrounded by a narrow teak moulding for appearance. The lower portion of the switchboard is covered in with sheet steel. Switches are only provided in one pole of the circuits, the bus bar for the other pole being connected to an earth plate through a plug fuse, which is mounted behind the switchboard. There is also fixed behind the switchboard the five small transformers for synchronising and for supplying the voltmeters.

The regulating table, as will be seen from the illustration, carries on the front of it four multiple contact regulating switches, three of these being for the alternator field, and the smaller one for the exciter field. Another regulating switch on the end of the table is connected in the field of the motor-alternator, and is used for varying the speed of this machine when synchronising. The top of the table is of slate, and has mounted on it field breaking switches for the three alternators, with ammeters for reading the field currents. A voltmeter is also provided for the exciter, this one being in parallel with one on the main switchboard. The framework of the table is made of steel angles. The resistances to which the regulating switches are connected are fixed in the space below the switchboard.

The low tension board, as shown, is arranged to connect up the exciter, the batteries, the motor of motor-alternator, the fields of the alternators, and the works' circuit. Two sets of bus bars are provided, and the switches of the exciter and motor fields can be thrown on to either of these bars. By this arrangement the batteries can be charged from one bus bar at 135 volts, and at the same time discharge on to the other bar at 100 volts to supply various circuits. This switchboard is divided into two panels. The left-hand panel carries the main switches for the exciter and station circuit. These are double-pole two-way of the throw-over type before mentioned, and are arranged to quick break into the middle position from either side. Seven other circuit switches are provided on this panel, three being for the alternator fields, three spare, and one for the motor of the motor-alternator circuit. These switches are two-way of the double-pole throw-over type, but they are not quick break; in the case of the field circuits the breaking being done on the switches before mentioned on the regulating table, and in the case of the motor by the starting switch. On the right-hand panel are the switches and instruments for controlling the battery circuits, and also for the motor of motor-alternator. In connection with the motor there is a nine-way starting switch, and two single-pole two-way change-over switches, one for the armature circuit, and one for the field circuit; the object of these latter two switches being to enable (in the case of an accident to the exciter) the motor-alternator to be reversed, converting it into an alternator-dynamo, the alternator being run as a motor from the large alternators, and the dynamo used for charging the batteries. In the ordinary use the batteries will be charged all in series, but should such an emergency occur, the alternator-dynamo would give current at 100 volts only, and the charging done by paralleling the batteries. At the top of the switchboard is provided a switch, which enables the batteries to be changed from series to parallel. When charging the batteries in parallel two five-way switches and resistances and ammeters are connected in each circuit for regulating the current. The battery circuit is provided with an automatic battery cut-out and cut-in switch. This is set so as to cut in when the pressure in the machine exceeds that of the batteries, and also to prevent the current reversing. A current alarm is fixed on the board to indicate by the ringing of a bell should the rate of discharge from the batteries be excessive. Two voltmeters are also fixed on this board.

The construction of this switchboard is exactly similar to that of the high tension board, and has the same vertical dimensions, so that when the additional circuit panels are erected on the high tension board they will form one complete board and be uniform in appearance.

Underground Mains.

The contract for the whole of the work in connection with the system of mains outside the station was placed in the hands of the Callender Cable and Construction Company, Limited. The type of cable employed both for the high tension feeder mains supplying the sub-stations and for the low pressure network from which consumers are connected consists of concentric conductors, each one insulated by a dielectric of bituminised fibre, the outer dielectric being

sheathed with a very heavy covering of lead, and finished by a yarn braid and compounded. These cables were drawn into the stoneware ducts or pipes. In certain instances it was found more convenient to armour the low pressure distributers, and they were then laid direct in the ground in the usual way.

Prior to the commencement of the operations in connection with the electric supply, certain alterations were made in the main thoroughfares of Morley, and advantage was then taken of the ground being open to lay wherever possible a conduit consisting of six-way Doulton casing, and 4-inch earthenware pipes. This system has been continued throughout the whole of the business portion of the town, with the exception that in crossing roadways strong cast-iron pipes have been substituted for the earthenware pipes or casing.

There are four high pressure feeder cables which supply the sub-stations direct from the generating station.

The low pressure network throughout consists of 37/14 concentric cable, and except where laid as armoured cable, these mains have been drawn into the 4-inch stoneware pipe previously referred to.

Arc lighting mains are laid on each side of Queen Street, extending from South Queen Street to Morley Bottoms. The lamps are supplied from the low pressure system, and the cables used are twin 7/16, with vulcanised bitumen dielectric lead sheathed and braided.

The whole of the mains were laid under the charge of Mr. F. B. Collard, who acted as resident engineer for the Callender Company.

Sub-Stations.

There are at present six sub-stations for dealing with the distribution. They have been equipped with E.C.C. switch gear and transformers. The special feature of the transformers is, that the magnetic circuit is circular with only one joint, thus giving the least magnetic resistance for a given area of winding. The stampings are also arranged in two sizes, to increase the effective cooling surface, the temperature rise of the iron being kept under 40° F. The 20 kw. transformers give a drop of 1·6 per cent., the open circuit loss being 215 watts at 60. The cases are of cast-iron, with large cooling surface, and are made quite water-tight.

The Corporation has adopted a small scheme of street lighting by electricity. Arc lamps are used up to midnight, and are then replaced by two incandescent erected half way up the pillars.

The arc lamps in use are 11 in number of the E.C.C. improved type, in which the feed is controlled by a brake wheel which is provided both with ratchet teeth and also a plain surface on its periphery, where two brakes are applied, one striking the arc, and the other giving such regulation as to allow the carbons to feed almost imperceptibly. The lamp is so constructed that it burns satisfactorily without a choking coil being inserted in the circuit. The lamps take 500 watts at a pressure of 39 volts, the current being supplied from a transformer for each lamp, reducing the voltage from 200 to that required by the lamp.

A low tension double-pole switch and fuse is fixed with the transformer in the base of each of the columns, also a change-over switch, which is for cutting out the arc lamps and putting in two 200 volts incandescent lamps.

The columns, which are 20 feet high to centre of arc, were supplied by Messrs. James Allan sen & Son, of Glasgow, and are of an ornamental design, fitted with overhanging bracket to carry the arc lamp, and with two brackets about 13 feet from the ground for the incandescent lamps.

The whole of the work has been carried out to the specification of Mr. Robert Hammond, the consulting engineer.

Electrical Patents.—We are informed by the secretary of the Institution of Electrical Engineers that arrangements have been made with the Patent Office under which there will be placed on the library table at the Institution every Monday morning a copy of each electrical patent specification published during the preceding week. The specifications will remain on the table for three weeks, and will then be filed.

ELECTRIC LIGHTING NOTES.

(*Continued from page* 84.)

Newcastle.—At the adjourned meeting of the Newcastle Town Council held on Wednesday last week, the report of the Special Committee appointed to consider the desirability of the Corporation undertaking the provision of electricity was presented. The report recommended that the committee be authorised to negotiate as to terms upon which the electric lighting companies would transfer their undertakings to the Corporation.—Councillor W. Smith, in moving the adoption of the report, asked that the Council give their sanction to negotiate with the two companies for the transfer of their businesses to the Corporation. If the company stated a price, the matter would have to come up again. They (the committee) did not know whether the companies would sell or not; if not, the committee would have another scheme to bring before the Council shortly. By adopting the report, the Council did not bind themselves to anything definite.—Alderman W. D. Stephens seconded the adoption of the report.—Mr. Councillor Morton asked if the committee had considered whether the Corporation could not commence to manufacture electricity themselves?—Councillor Smith replied that the committee had considered this.—Alderman Richardson asked if there had been any demand from the consumers of electricity for a supply by the Corporation? The consumers were perfectly satisfied. What advantage was to come from a supply by the Corporation? What was to be gained by taking over the two works? It was certain the public consumers could not gain, so far as the lighting of the streets were concerned. It would be unwise if the Corporation took any further proceedings in the matter that day.—Alderman Newton was of opinion that if a profit was derived from lighting the city by electricity, it ought to be in the hands of the municipality. The question ought not to be shelved or dropped.—Councillor Baty moved that the matter be referred back to the committee for further consideration. This was ultimately seconded.—Councillor T. Cairns said if the Corporation could bring under one roof and one administration the undertakings of the two companies, and then determine upon electric traction for the trams, the public would receive enormous benefit.—Alderman Barker Ellis said that the Newcastle Corporation were being charged £42 a lamp for the electric light, and the Edinburgh committee were simply charging the Corporation £18 for the same amount, and were going to reduce it to £14.—Alderman Baxter Ellis declared that the whole and sole authority responsible for the electric monopoly was the Town Improvem nt Committee.—After further discussion the question was put to the vote, with the result that 34 voted for the amendment, and 17 against. The report thus will be referred back to the committee.

Northwich.—The Urban District Council have decided to light the streets with electricity. The successful results of the experimental lighting of the Market Hall has induced them to consider public lighting; four 10-ampere "Blahnik" arc lamps were used for the Market Hall, the cost of the same coming out at 10 per cent. less than the gas. The four lamps are going to be placed in High Street, also a number of incandescent lamps as an experiment, the current being given free by the Supply Company. Over 500 16-C.P. lamps have been applied for within the last month, and 275 have been coupled to the mains. The Supply Company are about to put down a third engine and dynamo. Extensive main extensions are also in progress.

Plumstead.—The Plumstead Vestry, who are considering the question of applying for a provisional order for an electric supply, have received notice from the Woolwich District Electric Light Company of their intention to apply for powers to light Plumstead with electricity. The Vestry have decided to oppose the granting of the order.

Ravensthorpe.—A communication has been received by the Ravensthorpe District Council from the Electrical Power Distribution Company, giving notice of their intention to apply for a provisional order empowering them to supply electricity within the Council's area, and asking the Council to assent to the application. It was decided not to do so, and the clerk was instructed to write to the Board of Trade accordingly.

Reading.—The company is altering its standard pressure of supply from 100 to 200 volts.

Rugby.—At the meeting of the Urban District Council on Thursday night last week a letter was received from the Edmundson Electricity Corporation, Limited, Westminster, London, giving statutory notice, on behalf of the Urban Electric Supply Company, Limited, that they intend to apply for a provisional order. The matter was referred to the General Purposes Committee.

Runcorn.—The Electrical Power Distribution Company, London, have notified their intention to apply to the Board of Trade for a provisional order to supply electricity in the district. The Council, believing such power should be vested in the Council, have decided to make a similar application in opposition.

Sale.—An electric lighting scheme which has been prepared for the District Council is to be submitted to Prof. Kennedy.

St. James's and Pall Mall Company.—The amount of electricity sold by the St. James's and Pall Mall Electric Light Company, Limited, for the quarter ending June 24th, 1898, is returned at 682,045 units, estimated to produce £14,209, as against 600,171 units for the same quarter of last year, which produced a net revenue of £13,158.

St. James's, Westminster.—The Vestry last week received a letter from the St. James's and Pall Mall Electric Lighting Company acknowledging the receipt of the Vestry's letter with reference to the company's charges for the supply of electricity. The letter intimated that the communication would be placed before the directors at the earliest opportunity.

Stone.—The Potteries Electric Traction Company, Limited, have notified the local authority that they intend to apply for lighting powers.

Uckfield.—The Crowborough Gas Company, Limited, have given notice to the Uckfield Rural District of their intention to apply for a provisional order for lighting the whole of the rural district of Uckfield with electricity.

Weybridge.—Mr. Edmund Bax, of Eldon, Weybridge, has written to the Weybridge Urban District Council with reference to the serving of notice upon the Council by the Electric Works Company, Limited, of their intention to apply to the Board of Trade for a provisional order for the lighting of Weybridge and Walton. Mr. Bax explained that the proposed order would ask for 42 years as the term within which the undertaking could be purchased, 8d. per unit would be the maximum price for energy, and that either local authority should have the power to purchase that part of the undertaking within its district, on giving 12 months' notice, at £133 for every £100 properly expended, with the proviso that if such power be exercised before 21 years, a further 5 per cent. on the capital properly expended should be paid, unless the dividends should in the aggregate have equalled 5 per cent. per annum from the commencement. The Council have referred the matter to the Highways and Lighting Committee.

Weymouth.—Thus far only four tradesmen of this town have adopted the electric light. The number will shortly be increased, as the palatial Royal Hotel now in course of construction is to be lighted by electricity, Messrs. Laing, Wharton & Down being entrusted with the contract.

Weston-super-Mare.—In view of the Weston-super-Mare Urban District Council's intention to instal the electric light in the town, they have this week agreed to enter into a contract with the local gas company for the public lighting of the town for one year only.

Wolverhampton.—Mr. F. Harman Lewis, the electrical engineer for the borough of Wolverhampton, has been compelled, in consequence of ill health, to resign his appointment. In reporting this resignation to the Town Council, the General Purposes Committee state that Mr. Lewis was appointed in May, 1893, at a salary of £300 per annum. Immediately upon his appointment he undertook the revision of the important scheme then before them for lighting the borough by electricity. "In consequence of his proposals," the committee state, "fresh tenders were obtained, resulting in a reduction of £10,000 upon the original ones being effected, this being to a great extent due to the improved tenders, and to the economical revision of the scheme by Mr. Lewis. He also superintended the construction of the works, and thus a sum equal to 5 per cent. upon the amount of the tenders, which would have been payable, as at first intended, to an expert, was saved by the Corporation. A scheme for the extension of the undertaking, involving a heavy capital expenditure, has recently been prepared by Mr. Lewis, and will, at an early date, be submitted to the Council. It will probably be necessary, when carrying out this scheme, to have recourse from time to time to him for his advice, and he has promised that if, after his recovery, any matter should arise as to which his intimate knowledge of, and experience with the electric lighting undertaking can be of service to the Corporation, he will be most willing to render assistance." The Lighting Committee recommend the acceptance of Mr. Lewis's resignation by the General Purposes Committee with regret. The Lighting Committee have advised that his services should be retained as consulting engineer for 12 months, from June 24th last, at his present salary, having regard to their probably requiring his help in connection with the extension. The General Purposes Committee therefore recommend to the Council to retain Mr. Lewis's services on the conditions mentioned. The presentation of this report at the Town Council meeting on Monday gave rise to a somewhat lengthy discussion, and in the result it was decided to retain the services of the electrical engineer at a salary of £150 per annum.

Worthing.—Messrs. Burstall & Monkhouse were some time ago appointed consulting electrical engineers to the Corporation, and a motion to rescind the appointment was recently defeated by a large majority.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Chiswick.—The Electric Tramway Bill from Chiswick to Hounslow now awaits the third reading in the House of Lords, and as soon as the Royal assent is given the construction of the line to Hounslow will commence. It is intended subsequently to apply for powers to continue the service to Staines.

Clontarf and Hill of Howth Tramroad.—Mr. J. W. Lowther, the chairman of the Unopposed Committee which considered this Bill, has made the following report to the House of Commons:—"That the object of the Bill is the construction of a tramroad on the ordinary Irish railway gauge, partly on and alongside of public roads, and partly through other property, from the existing tramway of the Dublin United Tramway Company, Clontarf, to Howth, in the county of Dublin. That the motive power to be used on the tramroad is proposed to be mechanical, including electricity, but not steam power, to be applied in connection with a generating station at Clontarf of the Dublin United Tramways Company, whose carriages are also moved by electricity. That the tramroad is intended to cross on the level a tramway authorised by the Great Northern Railway (Ireland) Act, 1897, but not yet constructed, and clauses arranged between the promoters and the Great Northern Company were submitted to the Committee and inserted in the Bill for protecting the respective lines and avoiding danger at and near the point of crossing. That a report from the Board of Trade was laid before the committee, pursuant to Standing Order No. 145 A., respecting the tolls and the maximum rates and charges proposed to be authorised by the Bill, and the committee had amended the Bill to meet the observations contained in the report. That the Bill proposes to authorise the borrowing of a larger sum than was usually allowed in the case of Irish railways, and it would facilitate the raising of the capital required to carry out the undertaking, and that the restriction contained in Standing Order No. 153 need not be enforced in this case. That in pursuance of the resolution of the House of March 15th the committee had satisfied themselves that the powers given by clause 48, and so much of clause 2 referred to in such resolution, had been struck out of the Bill in its first passage through the House. There are no other circumstances of which, in the opinion of the committee, it is desirable that the House should be informed." Mr. Lowther further reported from the committee that they had examined the allegations of the Bill and found the same to be true, and had got through the Bill and made amendments thereunto.

Derby.—The Derby Town Council have, on the recommendation of the Highways Committee, decided to oppose the application to be made to the Light Railway Commissioners on July 19th by the promoters of the Derby and Ashbourne Electric Railway for an order to construct a light railway from Derby to Ashbourne. The railway, if carried out, would be a great boon to the inhabitants of the towns named and the villages and townships adjacent, and the objection of the Derby Corporation is practically of a formal character and made principally to obtain a *locus standi* at the inquiry. The proposed railway will run on the side of the road, and it is contemplated to acquire running powers over a portion of the Derby tram lines as far as the Great Northern Railway wharf.

Hampshire Light Railways.—The Earl of Jersey and Colonel Boughey, R.E., Light Railway Commissioners, held an inquiry at the Drill Hall, Cosham, on Wednesday, with the view of determining the expendiency of granting an application by the Hampshire Light Railways Company for an order to make a light railway from Cosham to Horndean, *vid* Purbrook and Waterlooville, to be worked by electricity. Mr. Vesey Knox, Q.C., M.P., and Mr. C. C. Dyer (instructed by Mr. A. Wallis White, solicitor, of Portsmouth), appeared in support of the application. The former gentleman, in opening the case, said the railway would start from Cosham, passing across the London and South-Western lines. The line then passed a short distance along the high road. The street through Cosham was rather narrow, and it was thought desirable, therefore, to carry the line over some fields. The line would pass up Portsdown Hill, but there was no gradient at all of a dangerous character. The scheme would bring an agricultural district, which was from three to five miles distant from a railway station, into communication with the South-Western railway station at Cosham and the Portsmouth tramway system. Mr. Alfred W. White, the principal local promoter of the scheme, and manager of the Portsmouth tramways, had been endeavouring to obtain accommodation for the district for many years. They believed that with an electric tramway, and with the suburban and agricultural traffic, the line could be rendered of great service and made to pay. It would be a great convenience to the military authorities, as it would be carried near the forts, which were often occupied by soldiers, and it would be available for the inmates of the military hospital, which was to be erected on the slopes of Portsdown Hill. The military authorities approved of the scheme.—The Earl of Jersey: Are they represented?—Mr. Vesey Knox said the colonel commanding Royal Engineers had given his opinion, but he was not authorised to represent the War Department. There was no doubt, he understood, that the Department would approve, although they had not actually a representative present.—Mr. A. W. White, J.P., was examined at some length in support of the scheme, which, he said, he had no doubt would be a great public advantage. In 1897 it had been suggested to him by the Royal Engineer authorities that a tram line should be carried to Portsdown Hill. He anticipated as one result of the making of the railway, that a large number of people would live in the district.—In cross-examination by Mr. Trevor Lloyd, Mr. White repudiated the idea that there would be any danger to the public, even in the narrowest parts of the roads.—Evidence as to the value of the line to agriculturists was given, stress being laid upon the facilities that would be provided for getting milk and butter into Portsmouth market.—The Hants County Council and other local bodies were represented, and obtained promises that certain matters of detail should receive attention. Upon this understanding the Commissioners announced, at the end of a lengthened investigation, that they should have much pleasure in recommending the Board of Trade to grant the order authorising the construction of the line.

Hanwell.—The Light Railway Commissioners have sanctioned the construction of a light railway from Hanwell to Uxbridge in extension of the tramway system. We learn also that an application will be made for a light railway to Staines from the Bell, Hounslow, when the new tram line is constructed.

Johnstone.—The British Electric Traction Company have intimated to the Johnstone Town Council their desire that the Corporation should send a deputation to the Continent at their expense to judge for themselves by personal inspection of the success of the system in operation.

The L.C.C. and Electric Traction.—During the discussion of the tramway question at Tuesday's meeting of the London County Council, as set forth in the report of the Highways Committee, the Earl of Onslow referred to the investigations made by the Highways Committee in the past, and to the then suggested improved methods of traction. There was nothing set forth in the present report of the committee in regard to electric traction. The noble earl thought the Council should have some explanation upon that point which would largely influence the Council in coming to a decision. Mr. Purchese said that there was no doubt the progressives would go in for electric traction by-and-bye. It had answered in other towns and would do so in London. Mr. Baker, referring to the observations by the Earl of Onslow, mentioned that as soon as the present Highways Committee was formed, steps were at once taken to investigate the question as to the most improved form of traction for London, and those inquiries were proceeding at the present time. Mr. J. W. Benn, chairman of the committee, said in the course of his reply to the discussion, that he need not refer to electric traction. When he drew attention to the fact that Mr. Allen Baker, vice-chairman of the committee, had devoted his attention to the subject, he thought the Council would accept the assurance that that important matter would not be overlooked.

Middlesbrough Tramways.—The Middlesbrough, Stockton and Thornaby Tramways was to be inspected by the Board of Trade on Tuesday. The line will probably be opened for public traffic to-morrow.

The Mumbles Railway.—It is said that the directors of the Swansea and Mumbles Railway Company have been approached with a view of selling the concern to a company who proposed to electrically equip the line, but they decided not to accept the offer. On account of the nuisance that has arisen on this line from the lack of Welsh coal, it has been decided to take the advice of an electrical expert.

Paisley.—In connection with the offer of the British Electric Traction Company to run the Paisley tramways by means of the trolley system, it is stated that a section of the Town Council have raised the proposal that they should approach the Glasgow Corporation to see if they would be willing to lease the burgh streets from the Council and work the tramways as a part of their system, in the same way as is done at Pollokshaws, Govan, and other places adjoining the city.

Portsmouth.—Electricity, says a local evening paper, promises to play a very conspicuous part in Portsmouth Dockyard in the near future. The Admiralty not only intend to use it for illuminating purposes, but also as the motive power for driving the whole of the machinery of the workshops. In fact, plans are already being prepared for the undertaking which, it is estimated, will cost about £250,000. The advantages of electricity over the present means of driving the machinery are many. Each shop now has its own boilers with a staff of workmen to attend upon them. But in the new scheme these will all be swept away, and in their place, on the site of the old convict prison, will be erected a central generating station that will provide current both for lighting the yard and driving the machinery. With the present boilers will disappear a great amount of smoke and dirt, and the shops will be healthier to work in.

Southport.—The provisional order has been drafted for electric tramways in Southport, and will be promoted in the next session of Parliament: the Board of Trade will not hold their usual local inquiry before November. The preliminaries are, therefore, well advanced, especially as the surveys are now nearly completed, and the work of preparing the plans has commenced.

Tramways in the Black Country.—A writer in the *Dudley Herald*, in speaking of the importance of electric tramways in the districts between Birmingham and Wolverhampton, argues against municipal tramways, on the grounds that it would be impossible to have a uniform system running through various districts.

Warwick.—A proposal to transfer the Warwick and Leamington Tramways to the British Electric Traction Company upon certain terms, has been adopted by the shareholders.

TELEGRAPH AND TELEPHONE NOTES.

Imperial Etiquette.—The following expression of opinion is extracted from the *Morning Post's* notes on our Colonial affairs:—"*Pacific Cable.*—The report of the committee which sat to hear evidence nearly two years ago on the subject of the Pacific cable still remains pigeon-holed at the Colonial Office. At the desire of the Colonial premiers last June, the discussion of the report was deferred until they had time to consider its contents. Twelve months have passed, and nothing has transpired to show that the report has even been before the Colonial Cabinets. Surely the time has come when official etiquette would not be infringed by making public the report in question. A great deal of fuss was made at Ottawa about the Pacific cable, and much pains were taken to get the best evidence, but it is useless to treat an Imperial subject in this way. If the cable is a necessity let us know it; if not, then let the subject be dropped, but do not let the whims of the Australian premiers keep back the publication any longer. As a rule Canada is very anxious to proceed with her proposals, but in this matter of the Pacific cable the Canadian Government appear quite satisfied to let things slide. What, too, is to be done about the Cape and Australian cable? That project seems also to have lapsed. Another matter of imperial interest which seems to be fading away is the question of the fast Atlantic service between Canada and the mother country. There was much discussion and a certain amount of public movement in both countries in regard to this fast service, but since the question of contract was settled the scheme seems to have lacked attention.

Independence Day.—The London staff of the Commercial Cable Company celebrated "Independence Day" on Monday, the 4th inst., by an "up river" excursion to Staines, per steam launch *Formosa*. The party, numbering about 40, accompanied by Mr. Fredk. Ward, manager in England, was met at its destination by Mr. G. G. Ward, vice-president and general manager of the company, and other gentlemen. A first-class luncheon was then partaken of at the Packhorse Hotel, at the conclusion of which the success of the company, health of its president, vice-president, and that of other prominent officers were duly toasted with enthusiasm. The party broke up at Kingston about 8 p.m., after a most pleasant run back, during which the opportunity of obtaining a photographic memento was taken, and a most enjoyable day's outing was terminated with musical honours to the vice-president and the manager in England, to whom, by their kindly presence and co-operation, the success of the trip was in a great measure due, and by a general expression on everyone's part that it had indeed been a "Glorious 4th."

Pacific Cable Route Survey.—Concerning this survey, which was called for some 10 years ago by the Imperial and Colonial Conference, we make the following extract from the *Geographical Journal*, which publishes a summary of Admiralty surveys during the year 1897:—"In the Pacific one of the surveying vessels made an extensive cruise to Honolulu, *vid* Palmyra and Fanning Islands, to search for reported shoals, survey islands, and obtain soundings at the same time, which would be useful for a Pacific cable. Lines of soundings were carried from Sydney to Fiji, Fiji to Sydney Island to Palmyra Island, and northward to a position about 150 miles southward of the Sandwich Islands; also from a position about 360 miles south-east of the Sandwich Islands to Fanning Island and Suva. Between Suva and Auckland a meridian distance was carried, also a line of soundings run to the eastward of former lines *en route*. From Auckland soundings were taken to North Cape and thence to Hobart. During this cruise Palmyra Island and anchorage was surveyed. Fanning Island was surveyed, the soundings being carried out to a sufficient distance to delineate the 1,000 fathoms' contour line, also plans made on large scales of English harbour and whaler anchorage." We may say that along the routes surveyed, as above mentioned, the soundings show that there is no difficulty whatever as regards depth to be expected in cable laying, not only between *Fiji* and Fanning or Palmyra Islands, but also along any one of the proposed routes from Australia or New Zealand, to Fanning Island or Palmyra Island.

The Proposed New Cable to the Cape.—In reference to the new cable to the Cape which has been suggested by the Eastern, the Eastern Extension, and the Eastern and South African Telegraph Companies, we gather from the *African Review* that the proposal does not meet with much encouragement in Cape Colony, and that a rider has been added to the Capetown Chamber of Commerce resolution regarding an all-British cable, to the effect that if the Imperial and the Colonial Governments do not themselves construct a cable, "any further communication with Europe should, if possible, be arranged without placing it in the hands of the same company as owns the two existing lines, and that in any case full information as to the proposed routes and the conditions of the contract be given to the public before the Government are committed to any action."—The Committee of Management were also empowered to communicate on the matter with the other Chambers of Commerce.—Mr. Heard, M.L.A., who moved the resolution, spoke of the recent statement of the Premier on the subject in the House. They were all agreed about the advisability of having an all-British cable, and that it should not be in the possession of any company, but of the Imperial Government. They had been left dependent upon one company for their communication with Europe, and, although the rates had been lowered, they were frequently put to disadvantage owing to breakdowns, &c.—Mr. Jagger said the chances were a hundred to one that they could not get the Imperial Government to lay a cable. There was a powerful company in possession, owning a third of the cable service of the world. Was it likely that they would quietly watch the Government lay another line without cutting rates. Another drawback to inviting Imperial co-operation was that it would take about five years to consider the question. He suggested that they should come to terms with the company. If they gave the company any privileges they could take the right to regulate rates. If that were done they could have the work done more quickly and more economically, and they would practically get all they wanted.—The resolution was carried, only one voting against it.

St. James's, Westminster.—The Vestry last week considered letters from various telephone subscribers calling attention to the inconvenience caused them, owing to having been deprived of the use of the telephone in consequence of the Heddon Street fire, and stating that the company had informed them that such inconvenience could not possibly arise if the Vestry would consent to the wires being placed underground, and asking the Vestry to favourably consider the subject. On the motion of Mr. Watson, the Vestry decided, in view of the gravity of the position, to issue a pamphlet to the public and the press, setting forth at length the attitude taken up by the Vestry in regard to the question of underground cables.

The Telegraph Wire Export Trade.—The returns just issued relating to the exports of telegraph wire and apparatus connected therewith from this country during June, show that the month's shipments were fairly satisfactory, the total value being given as no less than £145,281, as compared with only £41,944 in the preceding month, and £88,340 in June, 1897. The result of this activity during June has been to entirely alter the anticipated relative position of the figures for the six months. At the end of May the total for the year to that date was below that recorded for the same period of 1897. For the first half of the current year the value of the shipments has amounted to £500,896, or £30,170 more than in the same period of last year, and £157,633 more than in the first half of 1897.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1898 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Caimanera-Santiago de Cuba	June 10th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Cyprus-Latakia	Feb. 10th, 1898 ...	...
Maranham-Para	April 17th, 1898 ...	...
Hong Kong-Manila	May 3rd, 1898 ...	...
Lourenço Marques-Durban...	June 30th, 1898 ...	July 8th, 1898
Bilbao-Falmouth	July 9th, 1898 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Cartagena-Barranquilla ...	July 4th, 1896 ...	...

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—August 1st. The municipal authorities of Stavelot are inviting tenders until August 1st for the concession for the supply of electrical engines for lighting and power purposes in the town during a period of 30 years. Tenders to be sent to L'Administration Communale de Stavelot (Belgium). Particulars from the Secretariat de la Ville on payment of 4 francs.

Dublin.—July 23rd. The Great Northern Railway Company (Ireland) invite tenders for complete electric lighting installation for the premises at Amiens Street Terminus, Dublin. Specification from the secretary.

Eccles.—July 23rd. The Corporation of Eccles are prepared to receive tenders for the wiring of the Town Hall. See our "Official Notices."

Exeter.—July 25th. The Corporation require high and low tension concentric mains, transformers, meters, and a feed water heater. See our "Official Notices."

France.—The French Post and Telegraph Department in Paris is inviting tenders until the 26th inst. for the supply of 100 tons of homogenous iron wire 2½ mm. in diameter, 120 tons of ordinary galvanised iron wire 7 mm. in diameter, and 200 kilometres of submarine cable core. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris, from whence particulars may be obtained.

Hapton.—August 1st. The Parish Council ask for tenders for lighting the district by electricity to be sent to the clerk.

Melbourne.—Tenders are asked by the Melbourne City Council for 600,000 arc lamp carbons. See our "Official Notices."

Middlesbrough.—July 15th. The Tees Union Shipping Company are inviting tenders for the construction and erection of an electrical hoist upon their wharf at Middlesbrough. Particulars, &c., from Mr. J. G. W. Aldridge, 9, Victoria Street, S.W., and tenders to the secretary.

Russia.—Tenders are being invited until August 13th next by the municipal authorities of Tiflis, for the erection and equipment of a central station for the electric lighting, by means of arc lamps, of the public streets in the centre of the town. Particulars may be obtained from, and tenders to be sent to, La Mairie de Tiflis, Russia.

Shanghai.—August 10th. The Shanghai Municipal Council invites tenders for the supply of two 100-kw. direct coupled steam alternators, switchboard, and water-tube boiler. Particulars and specifications to be obtained from Messrs. John Pook & Co., 8, Jeffreys Square, St. Mary Axe, E.C., to whom tenders have to be sent. See our "Official Notices" June 24th.

Shoreditch.—July 18th. The Vestry invite tenders for the supply and erection of additional continuous current motor transformers with switch gear and extension to switchboard at the electric generating station, Coronet Street, Shoreditch. Specifications from Messrs. Kincaid, Waller & Manville, 29, Great George Street. See our "Official Notices."

St. Mary, Newington.—July 22nd. The Vestry ask for tenders for supply and laying of insulated mains, conduits, boxes, &c. See our "Official Notices."

Wigan.—Tenders are asked for the electric lighting of the Drill Hall on the occasion of the Wigan Trades, Commercial and Art Exhibition to be held from October 26th to December 7th. See our "Official Notices."

West Ham.—July 18th. The Council invite tenders for the Municipal Technical Institute for battery, two electro-motor experiment dynamos and transformers, machine tools and experimental steam engines. See our "Official Notices."

Yarmouth.—July 19th. The Corporation invite tenders for one 150-kw. high speed engine and alternator direct coupled. Specification from Mr. A. H. Preece, 39, Victoria Street, S.W.

CLOSED.

Leyton.—On the recommendation of the Electric Lighting Committee, the following tenders in connection with the extensions at the Central Electric Light Station were adopted:—Battery, Hart Secondary Storage Syndicate, Limited (£1,480); switchboards, General Electric Company (£150); boosters and accessories, General Electric Company and Messrs. Fuller & Co. (£246 17s. 6d. and £230 respectively).

Austria.—Messrs. Siemens & Halske, Berlin, have secured a contract to convert the horse tramways in the town of Salzburg into electric lines.

Exmouth.—The Electric Lighting Committee of the Urban District Council reported that they had accepted the tender of the Brush Electrical Engineering Company, Limited, to supply, deliver, and erect a 100-kilowatt steam alternator for £1,477 10s., the company undertaking to have the plant erected and ready for work not later than September 29th; the tender of Messrs. John Damerel and Son to supply a cable carrying waggon for £15 6s.; and the tender of Mr. W. Otton to supply 450 feet 1¼-inch diameter 4-strand best quality driving rope.

NOTES.

A New Institution.—The Institution of Electrical and Mechanical Engineers which we referred to last week, says the *Review of the River Plate*, of 18th ult., is rapidly taking shape, and the following circular has been sent to all those connected with the above professions:—

Dear Sir,—In view of the progress that is being made in electrical and mechanical works in this country, several gentlemen connected with same are of the opinion that the time has now arrived for the formation of an Institution of Electrical and Mechanical Engineers in this country, and they are firmly of the belief that such an Institution would materially tend to bind together all those employed in these works of progress, and would enable friendly discussions to take place concerning the more important topics of the day. As it is proposed to hold a preliminary meeting at an early date, when articles of association will be presented for the consideration of those who adhere to the movement, I am requested to ask for your adhesion, and also take this opportunity of asking you to mention the subject to any of your friends who may be interested in the movement, and who, through an oversight, may not have received a similar invitation.

An early reply will oblige,

Yours faithfully,

For the Initiators,

Ernesto Danvers,

M.I.E.E., London.

We offer Mr. Danvers our hearty good wishes for a successful issue to his labours.

Messrs. Schuckert & Co.—It is reported that Messrs. Schuckert & Co., of Nuremberg, are about to form a special company to exploit their electrical engineering specialities in England and the British Colonies.

Personal.—Mr. Handcock, of Handcock & Dykes, was on Saturday married at Bromley, Kent, to Miss Sophie Tulloch, daughter of Major Hector Tulloch, C.B., R.E., late chief engineering inspector of the Local Government Board.

It will be seen from our "Lighting Notes" that Mr. Harman Lewis is resigning his position as electrical engineer to the Wolverhampton Corporation on account of ill health. He will continue to act in a consulting capacity. Mr. Lewis's health has for some little time, unfortunately, completely broken down, and after the last year's work was completed Mr. Lewis felt that his present state of health precluded him from continuing work satisfactorily, and that the only thing for him to do to restore his health was to have an absolute and complete change of surroundings. This resignation was accepted by the Lighting Committee with regret. As stated in the report given in our "Electric Lighting Notes," Mr. Lewis has acted both as consulting and resident electrical engineer, and was the means of effecting a very considerable saving in the initial stage of this undertaking, amounting to some £10,000. As is perhaps generally known the system in operation in this town is quite up to date, being a 2,000-volt direct current system, with motor transformer sub-stations, and the many difficulties to be dealt with in the design, erection, and working of such a station must be experienced to be appreciated, and every credit is due to Mr. Lewis for his exceptionally good work. It is to be regretted that in view of the very excellent work done and results accomplished in Wolverhampton by Mr. Lewis, the Council were unable to agree to the recommendations of the Committee in their entirety.

Mr. Preece, C.B., has been nominated for a seat on the Harbour Trust of Carnarvon, near which town he has a residence.

Maponite.—We are not in a position to say much about this substitute for rubber and gutta-percha, as we do not know the material. Apparently it is a composition of some sort, and we know of 50 compositions in the rubber trade which would have the same result. In an article in the *Financial News* it is stated that a rubber spring block was destroyed by a pressure of 4½ tons. It must have been a very small block, as the usual tests on rubber springs used by the railways are as follows:—"A 4-inch buffer should compress to half its thickness under a load of from 4 to 6 tons. This buffer has then to be subjected to 10,000 blows equal to the compression without suffering damage." We, therefore, do not attach much importance to the statement that the maponite block had only gone very little under a pressure of 13½ tons after sustaining 22 severe (?) blows from a Nasmyth hammer.

An American-made Submarine Cable.—The John A. Roebling's Sons Co. (Trenton, N.J.) have completed, says the *India-Rubber World*, a large submarine cable for the Western Union Telegraph Company, to be used for the transmission of messages beneath the waters of Puget Sound, between Port Angeles and Victoria. The cable is 29 miles in length, and is divided into two sections. One section is 20 miles in length, and the other nine, the former requiring six cars, each of 27 tons capacity, and the latter three cars of like capacity, for their transportation. The cable was laid on the cars in the shape of a large figure 8, layer upon layer, and upright boards were placed along the sides of the cars to give them greater capacity. A temporary roof was built over the cable. The entire cable weighs 188 tons, and it was made at the rate of about a mile a day. The cable is a three-conductor one, gutta-percha insulated.

Weblyn v. Shoolbred.—This case was commenced on Wednesday before Mr. Verey, the Official Referee, prominent counsel being employed on both sides. The action was for damages, the plaintiff claiming that the defendant had negligently carried out electric wiring at 80, Strand, where the plaintiff was exhibiting a picture called "A Royal Harem," valued at £1,000. It was held by the plaintiff that a fire which had occurred and partially damaged the picture was due to the wiring being negligently carried out. (A full report of this case will appear next week.)

Motor Fans on Trains.—The *Electrical Engineer* of New York says:—"In our issue of June 16th, Dr. Margaret A. Cleaves made the interesting suggestion that it would be a good move on the part of railroad companies to put fan motors in their passenger cars in the summer time as a means of keeping the air fresh and pure. By a curious coincidence, the announcement is now made that the Baltimore and Ohio South-western Railway officials have solved the problem of cooling sleeping cars in stations at night. At Cincinnati, Louisville and St. Louis, this line has sleeping cars placed in the stations at 10 p.m., which do not depart until after midnight, and in order to make them comfortable and cool, it has placed 16-inch electric fans in each end of the sleepers, thus removing the heated and impure air from all parts of the car. The fans have been in operation about two weeks, and have been the subject of many favourable comments from the travelling public. This is certainly a step in the right direction, and a piece of judicious enterprise worthy of general imitation on all the railroads. Why should not all cars be sweetened and freshened in this way before taking on passengers? It would not be very expensive; in fact, it might more than pay for itself in the inducement thus given to ride rather than avoid, as one now does, the hot, stuffy, smelly cars that are so uninviting. Perhaps the innovation could be limited to certain cars where an extra payment is already asked. We can hardly be mistaken in supposing that it would be welcomed by a great many. Dr. Cleaves's idea of fan motors on the cars while in motion is not bad. It would enable one to close the windows that now let dust and cinders in so freely, as the fans would keep the air circulating. The coming of electricity for traction purposes will soon render all these improvements far more possible and feasible than they now are."

Battlefield Communication.—It will be interesting, says *Electrical Engineer* of New York, to see how the present campaign in Cuba tests the utility of various means of communication on the battlefield, and how far our Signal Corps has perfected its system and apparatus. The tropical forest is not kindly disposed to aerial circuits, the tropical rainy season is not the best for high insulation, and the demands on vigilant inspection and maintenance will be heavy. In fact, a better opportunity to dispense with wires, and try the Marconi system from mountain top to mountain top could scarcely be found. There is also a good chance to test the serviceability of army balloons, and even of homing pigeons, as well as searchlight signals by night—any means, in short, that will keep a commanding officer in touch with his men, and informed of all that is occurring. We hope to record for General Greely, chief signal officer, and for the whole corps, a large amount of invaluable work.

From the River Plate.—*The Review of the River Plate* says: "In view of the protests lodged before the municipality by the gas and electric light companies in Buenos Ayres against the use of a bare neutral wire by the German Electric Light Company, the municipality has appointed Dr. Bahia to report on the *pros* and *cons* of the case with as little delay as possible. If it is finally resolved not to allow the use of a bare neutral in the mains of the German Company, we presume that no other companies will be allowed to use an earthed wire, even if only in house installations, carried out on the concentric system with an earthed outer. If this system were adopted in all the installations there would be nothing to say against it, but when it is only employed here and there, the danger from fire becomes very great. In this question of bare neutrals and outers in concentric we are of the opinion that the insurance companies are the ones who should have most to say in the matter, and we understand that special rules are being prepared which will be adopted should its use be allowed by the authorities."

Society of Engineers.—An extremely interesting visit was made by a party of the members of the Society of Engineers on Wednesday last to the London, Brighton and South Coast Railway locomotive works at Brighton, the Brighton Marine Palace and Pier Works, Volk's Electric Railway, and the Brighton and Rottingdean Sea-shore Electric Tramroad.

Marriage.—Mr. J. M. G. Trezise, who for some years past has been connected with the electrical engineering department of the Post Office, was married on Wednesday last, July 6th, to Miss Angus Octavia Jay, of South Kensington. The ceremony, which was fully choral, took place at St. Mary Abbott's Church. We understand that the happy couple are now spending a few weeks in the vicinity of the Norfolk Broads.

Lighthouse Illumination.—It is said that the *Irene* Trinity yacht, with Captains Vyvyan and Slader, Elder Brethren of the Trinity House, arrived at Yarmouth last Saturday, and inspected the district store-house and Caister lights on Monday, to inaugurate what may prove to be a most important improvement in coast illumination, viz., the adoption of the incandescent gas burner, which was introduced for the first time, as far as our coasts are concerned, at the Caister leading lights, on the Britannia Pier and at the Sailors' Home. On Monday night the visitors proceeded as far as the Cockle light-vessel to view the lights, which were a marked improvement on the old ones, showing clearly, and distinctly superior to the electric lights by which they were surrounded, and to the mariner an increase of illuminating power from 3,000 to 10,000 candles.

NEW COMPANIES REGISTERED.

London Steam Omnibus Company, Limited (58,017).—This company was registered on June 30th, with a capital of £420,000 in £10 shares (2,000 founders'), to enter into an agreement with the British Motor Company, Limited, and to carry on the business of omnibus, van, carriage, steamboat, and launch proprietors and builders, livery stable keepers, job masters, carriers, cycle manufacturers and dealers, electrical and mechanical engineers, electricians, machinists, fitters, founders, wire drawers, tube makers, smiths, metallurgists, &c. The subscribers (with one share each) are:—H. W. Brown, 79, High Street, Beckenham, journalist; E. T. Church, 48, Geneva Road, Brixton, S.W., clerk; A. D. Brown, 31, Reighton Road, Upper Clapton, N.E., writer; A. J. Swan, 124, Peckham Rye, S.E., gentleman; J. Peacock, 32, Park Street, Islington, N., clerk; H. Paul, 18, Appach Road, Brixton Hill, S.W., reporter; J. W. Honess, 35, Florence Road, Wimbledon, gentleman. The number of directors is not to be less than three nor more than eight; the subscribers are to appoint the first; qualification, £200; remuneration, chairman, 400 guineas; deputy chairman, 350 guineas; and others, 300 guineas each per annum.

News and Entertainment Telephone Syndicate, Limited (58,064).—This company was registered on July 4th, with a capital of £10,000 in £1 shares, to adopt an agreement with Lazarus Blumenthal, to acquire any patents and rights connected with telephones or electrophones, or with the transmission and reproduction of news or entertainments, and to carry on the business of electricians, electrical, mechanical, metallurgical, and chemical engineers, battery makers, &c. The subscribers (with one share each) are:—J. A. Fuller, 50, Chatterton Road, Finsbury Park, N., clerk; J. M. Lickfold, 33, Brunswick Square, W.C., journalist; A. D. Brown, 31, Reighton Road, Upper Clapton, writer; A. J. Swan, 124, Peckham Rye, S.E., gentleman; J. Peacock, 32, Park Street, Islington, clerk; H. F. Carr, Bedford Park, Chiswick, W., clerk; H. Spinks, 59, Church Road, Homerton, clerk. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; remuneration as fixed by the company.

Nernst Lamp Company, Limited (58,057).—This company was registered on July 4th, with a capital of £17,000 in £1 shares, to adopt an agreement with B. Zusman, and to carry on the business of makers of electric lamps and accessories, iron and brass founders, glass smelters, porcelain manufacturers, wood and metal turners, brass, copper, iron, and platinum wire drawers, &c. The subscribers are:—T. G. Fort, Forest Lodge, Ashstead, gentleman, 1,000 shares; E. Hooper, Broad Street House, E.C., engineer, 500 shares; H. Oppenheimer, 55, Redcross Street, E.C., electrical engineer, 600 shares; E. Lazarus, 5, Bloomsbury Square, E.C., solicitor, 475 shares; E. Spiegel, 120, Bishopsgate Street, E.C., foreign banker, 250 shares; J. I. Wyler, 2, Copthall Buildings, E.C., stockbroker, 100 shares; G. Byng, 71, Queen Victoria Street, E.C., manufacturer, 400 shares. Registered without articles of association. Registered office, 130, Dashwood House, New Broad Street, E.C.

Western Canada Telephone Company, Limited (58,073).—This company was registered on July 5th, with a capital of £60,000 in £100 shares, to acquire, develop, turn to account and deal with any telephone lines and any machinery, plant, effects and shares of any telephone company in British Columbia or Canada, and to carry on the business of financiers and company promoters. The subscribers (with one share each) are:—J. Wheatley, Woodlands, Mirfield, woollen manufacturer; J. Crowther, Woodley, Huddersfield, woollen manufacturer; W. D. Shaw, Holmefield, Ladywood, cotton spinner; G. Sheard, Woodlands, Batley, woollen manufacturer; R. I. Critchley, Hyrst House, Dewsbury, coal owner; F. Priestman, Pierremont, Manningham, Bradford, worsted spinner; J. H. Wade, 8, Piccadilly, Bradford, solicitor. Table "A" mainly applies.

Caoutchouc Company, Limited (58,151).—This company was registered on July 11th, with a capital of £50,000 in £1 shares, to acquire and carry on the business of manufacturers of India-rubber carried on by Henry Edmunds, James E. Baxter, and George E. Heyl-Dia at Leyland, Lancashire, under the style of "The Caoutchouc Company," to adopt an agreement with the said vendors, and to apply a secret process to the insulation of telegraphic, telephonic and electric wires, and cables and appliances. The subscribers (with one share each) are:—J. E. Baxter, Highfield, Leyland, Lancashire, rubber manufacturer; H. Edmunds, 39, Victoria Street, S.W., electrical engineer; G. E. Heyl-Dia, 236, Great Clowes Street, Manchester, electrical engineer; C. J. Beaver, Vernon Place, Leyland, engineer; T. Smith, 10, Moss Lane, Leyland, book-keeper; W. S. Edelston, 7, Winckley Street, Preston, solicitor; J. Shutt, Holme House, Farington, near Preston, secretary. The number of the directors is not to be less than two nor more than five. The first are: Henry Edmunds, James E. Baxter, and George E. Heyl-Dia; qualification, £500; remuneration, 10 per cent. of the net profits, after the payment of a 10 per cent. dividend, the same to be divisible. Registered office, Wheelton Lane, Leyland, Lancashire.

Hodges & Todd, Limited (58,153).—This company was registered on July 11th, with a capital of £25,000 in £1 shares, to adopt an agreement with Herbert C. Hodges, Percy W. O. Hodges, and John Todd, for the acquisition of the business of "Hodges and Todd," and to carry on the business of suppliers of electricity, electricians, electrical and mechanical engineers, &c. The subscribers (with one share each) are:—H. C. Hodges, 30, Hampstead Road, N.W., electrical engineer; P. W. O. Hodges, 30, Hampstead Road, N.W., electrical engineer; J. Todd, 30, Hampstead Road, N.W., electrical engineer; J. Masterton, 11, Brixton Road, S.W., clerk; G. Charles, 143, Ball's Pond Road, Islington, engineer; J. J. M. Browning, 8, Harold Street, Camberwell, electrical engineer; P. E. E. Lewis, Fairlop Road, Leytonstone, electrical engineer. The number of directors is not to be less than three nor more than seven; the first are the first three subscribers; qualification, £500; remuneration, £100 each per annum.

Telegraph Manufacturing Company, Limited (58,158).—This company was registered on July 11th, with a capital of £200,000 in £5 shares (20,000 preference), to enter into an agreement with a company of the same name (registered in 1886) and John Brotherton, its liquidator, for the acquisition of its business, and to carry on the business of electrical, mechanical and general engineers and contractors, manufacturers of and dealers in wires, cables, and all kinds of electrical materials and apparatus, electricians, machinists, suppliers of electricity, &c. The subscribers (with one share each) are:—J. Brotherton, Elm Cottage, Helsby, secretary; J. Taylor, Heathercliffe, Helsby, manufacturer; G. C. Taylor, Ravenscar, Helsby, manufacturer; F. Whiteley, Oakcliffe, Helsby, manufacturer; A. Whalley, Ashville, Helsby, engineer; E. R. Pearson, Victoria Road, Runcorn, clerk; G. Seddon, 49, Halkyn Road, Hoole, Chester, clerk. The number of directors is not to be less than three nor more than five. The first are: James Taylor, Dr. John Hopkinson, George C. Taylor, and Frederick Whiteley. Qualification, £2,000; remuneration, £200 each per annum.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Browett, Lindley & Co., Limited (32,584).—This company's annual return was filed on May 7th. The capital is £30,000 in 2,100 ordinary and 900 preference shares of £10 each; 1,712 ordinary and 550 preference shares have been taken up, and 800 ordinary shares are considered as paid; £10 per share has been called on the rest, and £14,620 has been paid.

CITY NOTES.

Electrical Power Storage Company, Limited.

The report of the directors, presented yesterday to the ordinary general meeting, stated that the net profit for the year is £4,389 6s. 5d., which, with a balance of £242 0s. 2d. from last year, amounts to £4,631 6s. 7d., out of which the directors recommend the payment of a dividend of 5 per cent. on the ordinary share capital, which will absorb £4,274 16d., leaving £356 10s. 7d. to be carried forward. Provision has been made for the maintenance of buildings, plant, tools, &c., at a cost of £2,610 12s. 1d. A considerable portion of the area obtained during last year for the extension of the Millwall works has now been built upon, and the shops fitted with newest types of machinery. The increased facilities thus obtained have enabled the company to keep pace with the growing demands for its manufactures. The company is now producing nearly all standard British and Continental types of secondary batteries, provided with Planté formed or pasted plates, and is thus in an exceptional position for executing contracts to the various

requirements of consulting and acting engineers throughout the country. The directors are pleased to announce that during the year a Royal Warrant has been issued appointing the company storage battery makers to Her Majesty the Queen. This is the first and only Royal Warrant which has been granted for any electrical appliances. Owing to ill health, Mr. Frank King, who has been manager of the present company since its formation, has tendered his resignation. The directors have accepted it with the utmost regret, and have unanimously elected him to a seat at the board.

The Electric Construction Company, Limited.

The report of the directors, to be submitted to the shareholders at the fifth annual general meeting of the Electric Construction Company, Limited, to be held on Thursday, July 21st, 1898, at Winchester House, 50, Old Broad Street, London, E.C., at 2.30 p.m., states that the net profits of the year are £18,854 7s., and adding the balance brought from last year, £16,499 0s. 9d., the amount available for dividend is £35,353 7s. 9d. The directors recommend payment, on July 30th, of a dividend of 7 per cent. on the preference shares, and of 6 per cent. on the ordinary shares, one-half on July 30th and the other on January 31st next. These dividends will absorb £16,274 7s. 3d., and the directors further recommend that £17,000 of the surplus, together with the £23,000 now at credit of depreciation account, be transferred to a general reserve and depreciation account, which would thus amount to £40,000; the balance of £2,079 0s. 6d. remaining at credit of profit and loss account, to be carried forward. The buildings and plant have been fully maintained, and adequate depreciation provided, as formerly, out of revenue. Only such additions as tend to increase of output or to economy in production are charged to capital account. The business continues to make satisfactory development, both in respect of quantity and novelty of machines manufactured, and its growth has necessitated further additions to buildings and plant. During the year several installations of central station plant have been successfully completed, including the Halifax electric tramways. An important contract has recently been concluded with the City and South London Railway Company for the electrical equipment of its extension to Moorgate Street. It is not expected that the Workmen's Compensation Act, 1897, will affect the company to any important extent, as there has been no serious accident in the works during the last five years. The financial arrangements mentioned in last report have been successfully carried out. 8,657 preference shares were issued to shareholders at a premium of 15s. per share, and a 4 per cent. debenture stock has been created to redeem the 6 per cent. first mortgage debentures. Holders of £112,800 of the debentures exchanged them in January for an equal amount of stock and a premium of 3 per cent., and the balance of £37,200 will be dealt with on the 15th current. The 6 per cent. second mortgage debentures are repayable by half-yearly drawings. The directors who retire by rotation at the general meeting (and are eligible for re-election) are Messrs. Barclay and Courtenay. Messrs. James Meston and Co., the auditors for the past year, offer themselves for re-election.

Crompton & Co., Limited.

The tenth report of the directors, to be presented at the annual general meeting of the shareholders at the City Terminus Hotel, Cannon Street, in the City of London, on Thursday, July 21st, 1898, at 3 o'clock, states that the net profits for the year amount to £13,568 14s. 4d. Seeing that during nearly six months of the year the engineering trade was disorganised by the disastrous strike of the workmen, and secondly that the removal of the machinery from the old works to the new was effected during the past 12 months, the result of the year's working may be considered reasonably satisfactory. After providing for debenture interest and the other payments set out in the net revenue account, there remains a balance of £4,606 17s. 11d., which the directors propose to carry forward. The new freehold works of the company are now equipped and in going order and the anticipations of the directors as to economies and speed of manufacture at these works have been fully realised. The manufacture of arc lamps, electrical measuring instruments, and switchboards is still being carried on at the old works. Probably it will be to the advantage of the company in the near future to conduct the whole of its manufactures in one place. Since January 1st the Chelmsford Electric Lighting Company has been in possession of the generating station and has been supplying current to the old works. The lighting is making satisfactory progress, and has declared a dividend of 4 per cent. upon its share capital for 1897. The business of manufacturing electrical machinery is in a satisfactory state, and, although better prices are being charged, the order book of the company is very full. Negotiations are also in a forward state for several important contracts at good prices. The directors believe that the prospects of the company have decidedly improved during the year. The resolutions for reduction of the capital of the company, passed by the shareholders last autumn, have been confirmed by the Court, and in the opinion of the directors, the statement now presented represents the actual financial position of the company. The whole of the assets have been thoroughly examined and written down to what is considered their proper values, and the board take this opportunity of congratulating the shareholders on their having taken the necessary steps to place their business on a sound footing. Mr. J. F. Albright has retired from the position of a director of the company, and it is not proposed to fill the vacancy at present. In accordance with the articles of association, Mr. Bernard Gibson retires from the board of directors by rotation, but offers himself for re-election. The auditors, Messrs. J. H. Duncan & Co., also offer themselves for re-election.

Edmundsons' Electricity Corporation.

The first ordinary general meeting of Edmundsons' Electricity Corporation, Limited, was held last Friday at the offices, Broad Sanctuary Chambers, Westminster, S.W., under the presidency of Mr. John R. Wigham, J.P.

The Chairman said: In 1895 they determined to extend their operations to town lighting, and undertook a contract for a central station at Shrewsbury, which was very successfully completed. Further contracts were obtained for central station lighting at Folkestone, Salisbury, Winchester, and Ventnor, and it was necessary to obtain additional capital to carry out these large works. They were advised that it would be necessary to reconstruct the old company, and to formally sell the business to a new company. Therefore this company was formed on that basis. The nominal capital was increased to £200,000, the actual amount at present issued being £153,000. The contracts in connection with these four towns have become the property of this company, and have been nearly completed, and they will all be in full working order ready for the coming winter's work. In addition to these towns, further town lighting has been secured. The works are well in hand and it is expected will also be completed ready for this winter's work at High Wycombe, Bromley, Chislehurst, Newmarket, and Alderley Edge. In all these country towns local companies have been formed, with the consent of the local authorities, to undertake the electric lighting powers conferred by Act of Parliament, and it is with these local companies that they had contracts for the construction of all the various works they require. The demand for current, so far, in those towns in which the works are approaching completion, is most satisfactory, and they have every reason to believe that the interest which they retain in these local companies will be a valuable one. The profit and loss account gives the result of 21 months' working, the company having taken over the business as a going concern from July 1st, 1896, and shows a profit of £7,645; but out of these profits the sum of £2,500 has been paid to the shareholders in the old company as interest on the purchase money for nine months, according to the arrangement made with that company. Under the head of assets, goodwill, leases, &c., £45,000, that amount ought to be greater by the sum of £9,000. The directors, in recommending that a dividend at the rate of 5 per cent. be paid upon the ordinary shares, would remind the shareholders that these shares are entitled to a cumulative 6 per cent. dividend before anything is paid on the deferred shares, and as only 5 per cent. is being paid this year, a farther 1 per cent. is due on these shares before any dividend can be paid on the deferred shares.

The motion for the adoption of the report and statement of accounts was unanimously agreed to.

Waterloo and City Railway Company.—The report for the past half-year states that the directors fully relied on the completion of the railway in the early part of the half-year, but their expectations have not been realised, and the opening for traffic cannot be arranged before August 1st next, on which date the train services will be commenced by the South-Western Railway Company, under the agreement of March, 1894. The interest payable during construction of the railway was limited to £25,000 by the company's Act of 1893, and as that amount was reached with the distribution made in January last, there cannot now be any further similar payment to the proprietors out of capital.

The Direct United States Cable Company, Limited.—A final dividend of 3s. per share, and a bonus of 1s. per share (both free of income-tax), is to be recommended, such dividend and bonus to be payable on and after the 30th inst., making, with the three interim dividends already paid, a total distribution of 3¼ per cent. for the year ended June 30th last, and, after placing £10,000 to reserve fund account, carrying forward a balance of about £3,388. Notice is given that the transfer books of this company will be closed from July 12th to the 26th, both days inclusive.

Blackheath and Greenwich District Electricity Company.—This company has been asking for subscription during the past week for £148,000 £1 shares.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending July 9th, 1898, were £3,181 14s. 2d.; corresponding period 1897, £2,606 19s. 9d.; increase, £522 14s. 5d.

The City and South London Railway Company.—The receipts for the week ending July 10th, 1898, were £913; week ending July 11th, 1897, £902; increase, £11; total receipts for half-year, 1898, £1,901; corresponding period, 1897, £1,933; decrease, £32. Miles open 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending July 9th, 1898, were £201 2s. 11d.; total receipts to July 9th, 1898, £3,404 17s. 11d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for the week ending July 8th, 1898, were £858 4s. 9d.; corresponding week last year, £738 14s. 4d.; increase, £119 10s. 5d.; passengers carried, 123,826; corresponding week last year, 105,585; aggregate to date, £919 16s. 7d.; aggregate to date last year, £817 3s. 2d.; increase to date, £102 13s. 5d.; mileage open, 8 miles.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 10th, 1898, amounted to £1,589; corresponding week last year, £1,483; increase, £106.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending July 9th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,728.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, July 6th.	Closing Quotation, July 13th.	Business done during week ended July 13th, 1898. Highest.	Lowest.
137,400l	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	99 —103xd	99 —103	102	100
25,000	Amazon Telegraph, shares	10	...	...	...	6 — 7	6 — 7	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	92 — 95xd	92 — 95	...	...
923,960l	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	65 — 68	64 — 67	65⅞	...
3,038,020l	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	116½—117½	116 —117	117¼	116
3,038,020l	Do. do. Deferred...	Stock	...	...	...	16⅜— 17¼	16½— 16⅝	16⅜	16¼
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15½— 16	15½— 16	16	15¹⁵⁄₁₆
75,000l	Do. do. 5 % Debs. 2nd series, 1906 ...	100	5 %	...	...	111 —115 xd	111 —115	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2⅜— 3¼	2⅜— 3¼	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297l	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105¼	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	3/16— 3/16	3/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	6½— 7⅜	6½— 7⅜	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	14½— 15½	14½— 15½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000l	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	4½ %	102—105% xd	102 —105%	...	...
60,710l	Direct United States Cable	20	2¼ %	2½ %	...	10⅜— 11¼	10⅜— 11¼	11⅛	10⅞
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100—103 xd	100 —103	...	...
400,000	Eastern Telegraph, Nos. 1 to 400,000	10	6½ %	6½ %	...	17½— 17⅝	17½— 17⅝	17¹¹⁄₁₆	17⅝
70,000	Do. 6 % Cum. Pref.	10	6	6 %	...	... ...	... ...	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,302,615l	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	123 —127	123 —127	125¼	123½
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	17½— 18	17½— 18	17¹¹⁄₁₆	17½
25,200l	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	98 —102 xd	98 —102	...	...
100,500l	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	99 —102 xd	99 —102	...	...
320,000l	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	124 —128	124 —128	127	124
35,100l	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	98 —103 xd	98 —103	100½	...
46,500l	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	99 —102 xd	99 —102	...	...
300,000l	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	101 —104	102 —105	...	...
200,000l	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	104 —107%	104 —107%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	4½ %	11½— 12	11½— 12	11⅞	11⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16½— 17	16½— 17	16⅞	16⅝
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	10 %	29 — 30	29 — 30	29⅝	...
160,000l	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	100 —103	101 —104	...	...
97,000	Halifax & Bermuda Cable, 4½% 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	99 —103 xd	99 —103	99½	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	50 — 53	50 — 53	53	52⅞
100,000l	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	108 —111	108 —111	...	...
28,000	Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000 ...	5	4 %	4 %	4 %	2¼— 2⅜	2¼— 2⅜	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	5½ %	6 %	5⅜— 5⅝	5⅜— 5⅝	5¹¹⁄₁₆	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	15½	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5⅛	5½
1,329,471l	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100—105 xd	100—105	101½	101
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	...	...
100,000l	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	4 %	104 —107 xd	104 —107	...	...
11,839	Reuter's	8	5 %	5 %	5 %	8 — 9	8 — 9	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	...	...
58,000	United River Plate Telephone	5	4 %	5 %	...	4¼— 4⅜	4½— 5	...	...
146,733l	Do. do. 5 % Debs.	Stock	5 %	...	...	103 —106 xd	103 —106	...	...
15,609	West African Telegraph, 7,501 to 23,109	10	4 %	*nil*	*nil*	3½— 4½	3½— 4½	...	...
213,400l	Do. do. 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	103 —106 xd	103 —106	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½ %	11¼— 11⅜	11½— 12	...	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	7¼— 7⅜	7½— 8	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	*nil*	½ %	4¼— 4⅜	4¼— 4⅜	...	...
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106 xd	103 —106	...	...
88,321	West India and Panama Telegraph	10	⅞ %	1 %	⅜ %	½— ¼	½— ¼	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	7⅜— 8¼	7⅜— 8¼	8	7¹³⁄₁₆
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	5 — 7	5 — 7	...	...
80,000l	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	104 —107 xd	104 —107	...	...
1,163,000$	Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	105 —110	105 —110	...	...
160,100l	Do. do. do. 6 % Ster. Bonds ...	100	6 %	6 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	11 — 12	11 — 12	11¼	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6¼	5⅜— 6¼	...	...
26,000	*Chelsea Electricity Supply, Ord., Nos. 1 to 10,277... ...	5	5 %	5 %	6 %	8 — 9 xd	8 — 9	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red....	Stock	4½ %	4½ %	4½ %	113 —115	113 —115	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	5 %	7 %	10 %	25¼— 26¼	25 — 26	25⅛	25⅛
10,000	Do. Prov. Certs. Nos. 90,001 to 100,000 £5 ...	10	...	...	...	25 — 26	25 — 26	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15½— 16½	16 — 17	16⅞	16¼
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	125 — 130xd	125 —130	...	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	*nil*	*nil*	*nil*	12½— 13½	12½— 13½	...	...
10,000	Do. do. do. Nos. 30,001 to 40,000 £6 paid.	10	...	...	...	8 — 9	8 — 9	8¼	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14½— 15½	14½— 15½	14⅝	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400 £6 paid	5	...	...	...	3½— 4½	3½— 4½	4⅛	...
10,000	House-to-House Electric Light Supply, Ord., 101 to 10,100	5	...	...	4 %	8 — 9	8 — 9	...	...
10,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	7 %	9½— 10½	9½— 10½	...	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	14½— 15½	15 — 16	15¾	15⅜
220,000l	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	4½ %	116 —120	116 —120	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	14½— 15½	14½— 15½	14⅝	...
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½ %	10½ %	14½ %	15½— 16½	15½— 16½	16	15⅞
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9⅜	...
50,000	Do. do. 4 % Deb. Stock Red. ...	Stock	...	...	4 %	105 —108 xd	105 —108	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	1⅞— 2¼	1⅞— 2¼	2⅛	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	15 — 16	15 — 16	15¾	15

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation July 6th.	Closing Quotation July 13th.	Business done during week ended July 13th, 1898. Highest.	Lowest.
30,000	British Electric Traction	10	...	...	...	17 — 17⅛	16½— 17	16¾	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 £7 pd. (issued at £2 10s. prem. all pd.)	10	...	...	...	10½— 11	10½— 11	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1⅜— 2	1⅜— 2	1 15/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2 — 2¼	2 — 2¼	2¼	2 3/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	99 —102	100 —103	...	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9⅜— 10¼	10⅜	10 3/16
129,179	Do. do. do. £6 paid	10	...	...	...	5⅜— 6¼	5⅜— 6¼	6¼	...
59,254	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅜	1¼— 1⅜	1¼	...
67,680	Do. do. Def. do. £5 paid ...	...	...	...	...	4¼— 4⅜	4¼— 4⅜	4⅓	...
630,000*l*	City and South London Railway	Stock	1 15/16%	1 15/16%	1⅞%	68 — 71	69 — 71	70⅜	69¼
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £3 pd.	10	...	...	...	2⅜— 3⅛	2⅜— 3⅛	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1¾— 2¼	1¾— 2¼	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	88 — 93	89 — 94	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5⅛%	...	2¼— 2⅜	2¼— 2⅜	2⅜	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5⅛%	...	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	101 —103xd	101 —103	...	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	6 %	2⅝— 2⅞	2¼— 2⅜	2⅜	2 5/16
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	7 %	3⅛— 3⅜	3⅛— 3⅜	3 3/16	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	106 —108	107 —109	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜— ⅝	⅜— ⅝	½	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	¼— ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	8 — 10xd	8 — 10	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	21½— 22½	21½— 22½	22¼	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½— 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21½— 22½	21½— 22½	22⅛	21¾
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	2⅞%	3¼%	10⅜— 10½	10⅜— 10½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15¾— 16¼	15¾— 16¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 39	36 — 39	38½	37
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	100 —103xd	100 —103	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	122 —127	119 —124	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.

House-to-House, 4½% Debentures of £100, 106—109.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—14; 1st Preference Cumulative 6%, £5 (fully paid), 8—8½. Debentures, 106—108. Dividend, 1897, on Ordinary Shares 10%.

London Electric Supply Corporation, £5 Ordinary, 3¼—4.

*T. Parker, £10 (fully paid), 15.

Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8¼—8¾. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 2½ per cent. (June 30th, 1898).

ON THE SOURCE OF THE RÖNTGEN RAYS IN FOCUS TUBES.*

By ALAN A. CAMPBELL SWINTON. Communicated by Lord KELVIN, F.R.S. Received June 7th, read June 16th, 1898.

The writer has already described ("Some new Studies in Cathode and Röntgen Radiations," a discourse given at the Royal Institution on February 4th, 1898) how he has found it possible to study by means of pin-hole photography the active area on the anti-cathode of a focus tube from which the Röntgen rays proceed.

By means of a special camera he has now been able to make further investigations. The camera is illustrated in fig. 1, where A is the pin-hole in a removable lead disc secured by a brass cap to the brass cone B, which is lined with thick lead so as to be opaque to the Röntgen rays. D is a framework into which slides either the fluorescent screen E, or a carrier containing a sensitive plate should photographs be required. F is an observation tube for use with the fluorescent screen. It is made of insulating material to avoid danger of shocks.

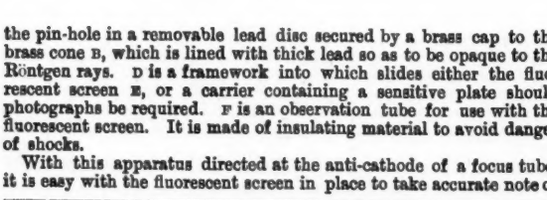


Fig. 1.

With this apparatus directed at the anti-cathode of a focus tube, it is easy with the fluorescent screen in place to take accurate note of the image of the active anti-cathode area which appears on the screen, and to observe the variations in form, dimensions, and brilliancy that take place under varying conditions. Similarly by replacing the fluorescent screen by a photographic plate in a black paper envelope, the Röntgen ray image can be photographed. Exposures, varying from 1 to 30 minutes, according to conditions, are found sufficient to impress upon the plate any effect that can be seen directly with the screen. It has not, however, been found possible, even with very prolonged exposures, to photograph anything not directly visible with the screen, and having regard to the difficulties of maintaining the vacuum and other conditions constant for any considerable length of time, the method of direct observation seems generally to be best and most convenient. For direct observation, rather a large pin-hole, say, about 2 mm. in diameter, gives the best results; for photography about half this diameter is preferable, as it gives sharper images.

The writer has made numerous observations and photographs with this apparatus, both with focus tubes of the ordinary pattern, and also with a special tube in which both the cathode and also the anti-cathode (which in addition acted as anode) were independently adjustable along the axis of the tube, so that the distance between them could be varied from a minimum of 4 to a maximum of 14 cm. This special tube is illustrated in fig. 2, and during the observations it was connected to a mercury pump so that the degree of exhaustion could be varied as desired.

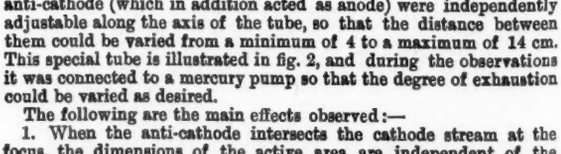


Fig. 2.

The following are the main effects observed:—

1. When the anti-cathode intersects the cathode stream at the focus, the dimensions of the active area are independent of the degree of exhaustion. For all other positions beyond the focus it is

* Paper read before the Royal Society.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

larger the lower the exhaustion and *vice versâ*. These observations are, of course, only possible between the limits of exhaustion with which Röntgen rays are produced.

2. When the anti-cathode intersects the cathode stream beyond the focus, the active area is larger the greater the distance between cathode and anti-cathode. For instance, with the tube illustrated in fig. 2., exhausted to a good Röntgen ray vacuum, it was found that the active area gradually increased from about 0·15 cm. diameter with 4 cm. distance between cathode and anti-cathode up to about 2·3 cm. diameter as the distance was gradually increased to 14 cm. The increase is less the higher the vacua, but is always very considerable.

3. When the anti-cathode intersects the cathode stream considerably beyond the focus, the active area is found to consist of a well defined and very intense central nucleus, surrounded by a much fainter but quite appreciable halo. Both of these increase in size as the distance between cathode and anti-cathode is increased.

In some cases the halo consists of a well marked hollow ring with a dark space between it and the central nucleus. In other cases two distinct concentric rings are visible surrounding the nucleus. Moreover, the nucleus itself, when very large, shows distinct signs of being made up of one or more concentric rings, sometimes with a still smaller nucleus within them. These observations correspond with and amplify what the writer has already noticed by direct observation of the visible luminescence of a carbon screen arranged to intersect the cathode stream.*

4. With an anti-cathode inclined at an angle of 45° to the axis of the conical cathode stream, it is found that those portions of the stream which impinge most normally upon the anti-cathode surface are considerably the most efficient in producing Röntgen rays. Similarly those portions of the stream that impinge on the anti-cathode surface very much on the slant are correspondingly ineffective in producing Röntgen rays.

5. At the degrees of exhaustion most suitable for producing Röntgen rays, and with concave cathodes of the usual dimensions, the cathode stream proceeds almost entirely from a small central portion of the cathode surface, the remaining portion of the surface being apparently practically inoperative. That this is so was very conclusively established by photographs taken with the tube shown in fig. 2. In the manufacture or subsequent exhaustion of this tube three very minute fragments of glass by some means attached themselves on to the concave surface of the aluminium cathode, and remained fixed there during the experiments. The cathode itself was 29 mm. diameter, and the radial distances of the three glass fragments from the centre were respectively about 9 mm., 4 mm., and 2·5 mm. In all the pin-hole photographs of the anti-cathode of this tube in which the enlargement of the active area was sufficient, the shadows of the two glass fragments nearest to the centre of the cathode are clearly visible, while in none of them is there any appearance of the third and outer fragment. It, therefore, is evident that the whole of the cathode stream that was effective in producing Röntgen rays came from an area of the cathode surface less than 18 mm. diameter, or less than two-thirds of the full diameter of the cathode. Further, in each case the shadows of the two inner glass fragments appeared outside of the central nucleus, showing that the whole of the more intense portion of the cathode stream proceeded from a portion of the cathode surface less than 5 mm. in diameter. These results confirm the writer's observations made with carbon cathodes.†

6. The different portions of the cathode stream proceeding from different portions of the cathode, cross at the focus and diverge in a cone that retains any special characteristics of the convergent cone. The relative positions of the two inner glass fragments on the cathode, and the positions and enlargement of their shadows on the anti-cathode for different distances between the latter and the cathode, were found to show this very clearly.

7. Though by far the greater portion of the Röntgen rays given by a focus tube proceed from the active anti-cathode area, still, a very appreciable quantity is also given off by all those portions of the glass of the tube that shows the green fluorescence.

Using a somewhat large pin-hole, this is easily observed by turning the tube so that the more powerful rays from the anti-cathode cannot reach the pin-hole, when a Röntgen ray image of the whole of the fluorescent portions of the glass of the tube can be distinctly seen. Further, it is noticeable that that portion of the glass that shows the brightest fluorescence, *i.e.*, that part which lies in the path in which cathode rays would be reflected from the anti-cathode surface were they reflected according to the law of equal angles of incidence and reflection—gives off the most Röntgen rays, while those portions of the glass that show no fluorescence do not give off any Röntgen rays. The conclusion appears obvious that whatever produces the one also produces the other, but as has been pointed out by Prof. S. P. Thompson ‡ and others, the fluorescence is not due to the direct stream of rays from the cathode, which cannot reach portions of the glass that show fluorescence, but to some description of radiation that proceeds from the surface of the anti-cathode that faces the cathode. In the paper above referred to Prof. Thompson calls these radiations "para-cathodic rays," stating that they differ from the Röntgen rays in respect of their power of penetration, and in their capacity of being electrostatically and magnetically deflectable. In these respects the writer's experiments confirm those of Prof. Thompson, but when the latter goes on to differentiate these rays from ordinary cathode rays, on account of their not exciting Röntgen rays where they impinge on a solid surface, the writer is unable to agree, for as above stated, these rays do excite Röntgen rays where they impinge upon the glass walls of the tube; as mentioned, however, they do this only to an extent that is relatively very feeble, and so far as the author knows only discernable by the pin-hole method of observation, which no doubt explains Prof. Thompson's failure to observe the effect. The "para-cathodic" radiations in question do not, however, appear to be ordinary cathode rays. In the first place they do not proceed directly from the cathode, but only from the surface of the anti-cathode that faces the latter. Secondly, they do not appear to be negatively but positively charged, as can be ascertained by means of an exploring pole connected with an electroscope. The writer suggests that, assuming the correctness of the Crookes theory of the nature of the cathode rays, these "para-cathodic" rays may very probably consist of cathode ray particles which, having struck the anti-cathode, and having thus given up their negative charges and acquired positive charges, rebound, both by reason of their elasticity and also by repulsion from the anti-cathode. Perhaps owing to the comparative roughness of the anti-cathode surface, they fly off to some extent in all available directions, but they do so especially in that direction which the law of equal angles of incidence and reflection requires. It also appears very possible that these "para-cathodic" rays are identical with the positively electrified streams proceeding from the anode, which the writer has investigated by means of radiometer mill wheels, recently described in a paper to the Physical Society.

In any case, it seems clear that in the tubes observed and photographed with the pin-hole camera, the Röntgen rays given off by certain portions of the fluorescent glass are not originated by the impact of an ordinary cathode stream, but apparently by the impact of positively charged streams proceeding from the anti-cathode.

The writer is greatly indebted to Mr. J. C. M. Stanton and Mr. H. Tyson Wolff, for the construction of the apparatus described, as also for valuable assistance in the carrying out of the experiments.

* See *Proc. Roy. Soc.*, Vol. 61, pp. 81—84.
† *Ibid*, pp. 92—93.
‡ See *Phil. Trans.*, A., Vol 190, pp. 471—490.

GAS ENGINE RESEARCH.

IN the course of the investigation into the economy of the gas engine by the Gas Engine Research Committee, so ably explained by Prof. Burstall in his recent paper before the Institute of Mechanical Engineers, the system of investigation carried out was that—we had almost said inaugurated by the late Mr. Willans—of varying one condition at a time, and noting the changes due to that one variation, a system so productive of useful results in the case of the steam engine, and fully as desirable for the gas engine in which the number of factors to be considered is greater than in the case of the steam engine. The engine was tested at about half load by means of a brake, the engine being able to develop this power under all the conditions of speed, compression and richness of charge.

The engine employed was of 2 H.P. and made by Fielding & Platt, of Gloucester, with 6-inch × 12-inch cylinder, and with all valves on one detachable plate. Governing was by cut-out, and the speed could be varied between 120 and 205 revolutions, though at the lower speed some uncertainty in the results arises from lack of fly-wheel steadiness. The connecting rod could be varied as to length to give more compression, and the piston could be reduced by removal of a junk ring to give less compression. A total range of compression between 30 and 90 lbs. was thus obtained. Gas admission could be varied by throttling, and gas was measured by means of a holder of 100 cubic feet capacity, which ensured the gas sample taken to represent a test being the same as the whole of the gas used for that particular test. The holder was calibrated by means of a standard cubic foot meter, so that each division read correctly, the gas being corrected for temperature which was measured by a thermometer on the supply pipe to the engine. Air was drawn in through a meter, or rather, forced through a meter by a motor-driven fan at a constant pressure regulated by a gas governor. Jacket water was run from a suitably calibrated tank through the jacket to waste with thermometers at the inlet and outlet. In all the tests the thermometers had their bulbs bare to the substance measured, their stems being soldered by Thomas's fusible metal to screw plugs of brass. The jacket temperature was kept constant by regulating the water flow. In order to obtain true exhaust gas, unmixed with air of the idle strokes, a special valve was arranged to give a bubble of gas at each explosion, thereby avoiding the allowance usually made for the idle strokes. The gas receiver contained mercury, not water, thus obviating absorption of CO_2. The exhaust gas was collected by an electrical device, and precautions taken to secure it free of air. The sample bubble of gas is thus taken at each explosion from under the exhaust valve. The method obviously presupposes an absolute homogeneity of mixture in the cylinder, a somewhat doubtful matter which, however, might perhaps be settled by varying the electrical contact so as to take the sample at different parts of the exhaust stroke.

To measure the indicated horse-power regard was had to the widely different conditions under which an indicator works on a gas engine from what it does on a steam engine. In ordinary working a gas engine gives eight lines or four so-called diagrams, but the published diagrams include only two of these, namely, No. 1 and No. 2. The eight we ourselves recognise as being marked are as follows:—No. 1, the compression stroke of the explosive charge; No. 2, the explosive stroke; No. 3, the exhaust after explosion; No. 4, the indraft stroke for a non-explosive stroke; No. 5, the compression of a non-explosive stroke; No. 6, the expansion stroke following No. 5; No. 7, the exhaust stroke following No. 6; No. 8, the indraft of explosive mixture. In an engine under full load, Nos. 4, 5, 6, and 7 do not occur, but only Nos. 8, 1, 2, 3. If an engine omits to charge twice in succession, then Nos. 4, 5, 6, 7,

will be repeated at slightly less pressures, and with careful handling and fine pencil points there is a clearly distinct difference between idle exhaust or compression lines and working lines. Of the above eight lines from an engine missing half its possible explosions, Nos. 2 and 6 perform work; Nos. 1 and 5 are work absorbers. The so-called gas engine diagram is a combination of Nos. 1 and 2; Nos. 5 and 6 are cancelled out of most calculations as being equal and opposite, which they are not. Nor do Nos. 7 and 8 exactly cancel out, nor yet 3 and 4.

In the tests, the normal combined diagrams of lines 1 and 2 appear only to have been measured and taken to represent the indicated horse-power, the other lines being neglected as a part of the internal losses of the engine. We hope that future trials will give the brake H.P., as well as the indicated, as we think that the idle diagrams will then be represented and will assist to show probably the greater importance of full load in a gas than in a steam engine.

The indicator employed was the Wayne, which has a swinging flat piston rotating in the cylinder, and restrained by a spring in torsion and well away from heat effects. The recording point moves in a circular arc, and records on a concave sheet of smoked mica, the diagrams being fixed by an alcohol lacquer.

The mica is carried to and fro by a positive motion in each direction, and all diagrams are of the same length, the slide being moved by a steel wire. The scale of the indicator was 198 lbs., intended for 200 lbs. Diagrams were measured by means of a finely ruled sheet of glass, read by a magnifying glass.

(To be continued.)

PHYSICAL SOCIETY.

Ordinary Meeting, June 24th, 1898.

Mr. Walter Baily in the Chair.

Prof. Carus-Wilson exhibited an apparatus to illustrate the action of two electric motors, coupled in such a way as to admit of their rotating at different speeds. The two shafts are placed in line, and each is fitted with a bevel wheel, gearing into an intermediate wheel. The axis of the intermediate wheel is at right angles to the line of the motor shafts, and is free to rotate in a plane at right angles to that line. The motors can be made to rotate at different speeds by altering the strength of the magnets of either or both. The motion of the intermediate wheel depends upon the difference of the two speeds, or upon their mean, according to their relative directions of rotation. A simple graphic construction enables the action to be predetermined for any given load on the intermediate wheel. Calling the two motors A and B, and the intermediate wheel C, lines can be drawn on a base of current to represent the speeds and the torques for each motor. If the motions of A and B are in the same direction, the load or torque is the same on each, and of similar sign. Hence, as the load on the wheel C is increased, the speeds of A and B tend to become equal (if A had been running faster than B), and for a certain load on C the speeds of A and B will be equal. If the load on C is further increased, B will run faster than A. Also, there will be a certain value for the load on C, at which the motion of A will reverse. A further increase of the load on C will bring C to rest, A and B then rotating at equal speeds in opposite directions. When the load on C is nothing, let the motors rotate in opposite directions, A running faster than B. The motion of C now depends upon the difference of speeds of A and B. When a load is put on C, the motion of A is retarded, while that of B is assisted, hence B takes less current, and A takes more. The torques on the two motors, due to the load on C, are now of equal amount, but of opposite sign. As the load on C is increased, the speed of A is reduced, and that of B increased, until the two are equal, and C comes to rest. B is now acting as a generator, and sending current into A. If the load on C is simply that due to friction, the process cannot be carried further. But if the load on C is reversed, the speed of B becomes greater than that of A, and the motion of C is reversed. In the steering gear designed by the Union Electricitäts Gesellschaft, the intermediate wheel is made to actuate a rudder by differential action. The motion is reversed by making the speed of one motor greater or less than that of the other.

Mr. Lehfeldt then read a paper by Dr. Donnan on the Theory of the Hall Effect in a Binary Electrolyte.

In 1883 Roiti investigated the subject of a possible Hall effect in electrolytic solutions. He failed to obtain any positive result. Recently the question has been examined by Bagard, who noticed certain effects in aqueous solutions of zincic and cupric sulphates. Meanwhile, negative results have been observed by Florio. The author therefore discusses what effect might be expected by theory, on somewhat the same lines as those of Van Everdingen, jun., taking a more general case. So far as the present discussion goes, the author's theory is wholly in favour of the negative results of Roiti and Florio. It would appear that Bagard measured a phenomenon not contemplated by the theory as stated in the present treatment. Van Everdingen originally supported the positive results of Bagard; but his work, unfortunately, was rendered incorrect by the accidental omission of a numerical factor. He has since discovered the slip in his calculations, and now agrees with the author's conclusions.

The Chairman proposed votes of thanks to the authors, and the meeting adjourned until October, this being the last of the session.

LONDON COUNTY COUNCIL.

At the last week's meeting the following business was considered:—

The Council's Testing Station.

It was reported that the Board of Trade had approved the rules and scales of fees recently adopted by the Council with reference to testing and other services rendered by the Council under the Electric Lighting Acts. Copies of the rules and scales of fees have now been forwarded to the London local authorities and to the metropolitan electric lighting companies.

The Highways Committee obtained the sanction of the Council to purchase a portable recording voltmeter, a recording ammeter, and an electrostatic voltmeter for use as a standard of measurement of from 200 to 250 volts in connection with the meter-testing station.

Electric Supply in Several Districts.

Reporting upon notices received from the County of London and Brush Electric Lighting Company of intention to lay high and low tension mains in certain parts of Peckham and Dulwich, the Highways Committee stated that the works were in part a repetition of those disapproved by the Council at the beginning of May. Commenting upon this, the committee said "it is evidently the intention of the company to make use of its generating station in Wandsworth for the supply of electricity in the Camberwell area; the proposed works being apparently intended to form an extension of those in Streatham which were formally disapproved by the Council on March 29th. At that time a Joint Committee of both Houses of Parliament was considering points raised in certain Bills with reference to the supply of electricity by means generating stations outside the areas served. The report of the Joint Committee, which has since been published, appears rather to be in favour of the proposal to supply electrical energy in bulk by means of generating stations situated outside the areas to be supplied; but the report has, however, not yet been considered by either House of Parliament. The committee thought, therefore, that in view of the importance of the principles at stake, and having regard to the probability that complications will arise, when the time of purchase arrives should the generating station not form an intregral part of the system to be purchased, it is advisable that the Council should, until Parliament shall have come to a decision upon the subject, withhold sanction to the proposed works."

Electric Traction on the Underground.

For the information of the Council, the Parliamentary Committee mentioned that the following clause has been inserted in the Metropolitan Railway Bill, which, it may be remembered, has passed the House of Commons, and has been before a Select Committee of the House of Lords. The clause reads:—

"If, at the expiration of three years from the passing of this Act, a system of electric traction has not been adopted upon the portion of the company's railway between Edgware Road and King's Cross stations, or if artificial means of ventilating the said portion of railway otherwise than by openings to the reasonable satisfaction of the Board of Trade have not been adopted, the company shall, if so required by the Board of Trade, close the openings for ventilation by this Act authorised to be made on the lands in the County of London by this Act authorised to be acquired, or such of the said openings as shall be specified in any requirement made by the Board of Trade under this section. Provided always that, if at the expiration of five years from the passing of this Act, such system of electric traction, or such artificial means of ventilation as aforesaid have not been adopted, the company shall close the said openings, unless authorised by Parliament to maintain the said openings, or any of them."

Subways for Electric Mains.

In connection with a proposal of the St. James's and Pall Mall Electric Lighting Company to lay new mains in various thoroughfares, the Highways Committee mentioned that one of the streets referred to in the company's notice was Shaftesbury Avenue, where a subway exists belonging to the Council. The Committee accordingly recommended that approval should be given to the application, on condition that the mains for Shaftesbury Avenue be laid in the subway in that thoroughfare, and that the company pay rent in accordance with the scale laid down by the Council, in respect of the user of such subway; that the position to be occupied by the mains in the subway be subject to the approval of the Council's chief engineer, and that the work of placing them be carried out, and any damage that may be done to the subway be made good, to his satisfaction.

Mains on Hampstead Heath.

The Parks Committee reported that the Vestry of Hampstead had applied for permission to lay a main at a depth of 2 feet 4 inches in the line of a track on Hampstead Heath, leading from the Spaniards' Road, near Jack Straw's Castle, to the Vale of Health. On the Committee's recommendation it was resolved to sanction the application on condition that the main be laid in a cast-iron pipe of a size and description to be approved by the Council's chief engineer, that as few drawing-in boxes as possible be used, that the work to be done and the ground made good to the satisfaction of the chief officer of the Parks Department, and that two days' notice be given before the commencement of the work.

Electric Traction in West London.

On the subject of the London United Tramways Bill, the Parliamentary Committee mentioned that it had been under consideration by a Select Committee of the House of Commons, the inquiry extending over no less than eight days. Mr. Benn, the chairman of

the Highways Committee, gave evidence in support of the Council's contention that the veto conferred upon the Council by the London United Tramways Order, 1895, with reference to this company's lines, should not be taken away. The Committee, after hearing Mr. Benn's evidence, decided that the veto should be retained, and the chairman of the Committee, in announcing the decision, stated that the Committee were of opinion that a sufficient case had not been made out for overriding the principle laid down by Parliament, which required the consent of the local authority, but that they considered that the congested state of London makes the speedy adoption of electric traction on tramways necessary, and that they earnestly trusted that arrangements might be made by the Council with the promoters by which the benefits of one system or other of electric traction might be secured to the public at the earliest possible date. The Bill, as it has now passed the Committee, authorises the construction of new lines in Heston, Isleworth, Brentford and Hanwell, but not in Ealing. The existing lines in Acton and the new lines may be worked by electric or other motive power.

The Parliamentary Committee did not consider that any further action was necessary on the part of the Council in regard to the Bill, and in this opinion they were supported by the Highways Committee.

The Transformer Box Question.

In connection with the laying of mains in Wandsworth, the County of London and Brush Electric Lighting Company desire to construct a transformer chamber of the type previously approved by the Board of Trade. As will be seen from the following from the report of the Highways Committee, the latter propose to contest each application before the Board of Trade and give unnecessary trouble to the company:—

"With regard to the proposed transformer box we are still of the opinion, which we have previously expressed, that such large portions of the public streets should not be appropriated for the purposes of a private undertaking. It will be remembered that the Board of Trade has on several occasions, on appeal having been made under Electric Lighting Orders, overruled the Council's refusal of sanction to the construction of large transformer boxes; and we are of opinion that, in order that the responsibility in the matter should rest wholly with the Board, the Council shall continue to withhold its sanction to the construction of any such boxes."

THE TELEPHONE INQUIRY.

(*Continued from page* 66.)

The Select Committee resumed the hearing of evidence on Thursday last, Mr. Hanbury presiding.

Mr. W. H. Preece, engineer and chief electrician to the Post Office, replying to the Chairman said he had had a very extensive acquaintance with telephones ever since they were introduced. He went to the United States in 1877, at the request of the then Postmaster-General, and brought over the first telephone into this country, and he had done his best ever since to develop the apparatus. He visited America again in 1884 and 1893, and, in 1895, being in Denmark on business connected with electrical communication between lighthouses, he took occasion with Mr. Lamb to run over to Sweden and Norway, and also to Germany. The results of those trips were embodied in a full and exhaustive report which had hitherto been regarded as confidential, but which he now desired to place before the Committee with the approval of the Postmaster-General. He had also visited France, Italy, and Belgium in connection with telephonic inquiries. There were some points to which he should like to call attention as to the telephone in Norway, Sweden and Germany. The first was with reference to the automatic switch which had been mentioned with approval by one or two witnesses, and he also wished to say that in all the reports he had seen put in to the Committee respecting Norway and Sweden, the tariff for the single wire circuit only had been given. As a matter of fact the supply of single wire circuits in Norway had ceased. Those who originally had the use of those circuits at a rental of £4 8s. 11d., were continued at that rate, and the use of the metallic circuit being optional with old subscribers. With new subscribers it was made compulsory and the charge was £7 15s. 8d.

The Chairman: With regard to these automatic switches, will you tell the Committee how they have broken down and why?—The objections that are raised to the use of the automatic switch are these—the switch necessarily assumes that the circuits are always idle, that they are always in working order, and thirdly, that the subscriber is always present. These are three assumptions which are rarely if ever existent, and it is through the breakdown of one or other of these assumptions that the switch has been found wanting. Continuing, the Witness said the present system involved the presence at the switchboard of cheap human intelligence in the shape of the girl operator. If they replaced this cheap labour by an automatic switch, in itself a very expensive piece of mechanism, they had to supplant that cheap labour by very highly paid technical labour at greater cost than they would save by the switch. He was aware that it was in operation in America, but he had very grave doubts about the accuracy of the reports received from that country. He had written for direct information from one of the places said to be so fitted up, and he would furnish the Committee with the reply when it came. Another reason for its breakdown was that the apparatus was extremely complicated, and was only applicable to a single exchange and not to junction and trunk working. In Norway and Sweden, where extremely simple switches were introduced and used only for five, seven, and nine subscribers, they had been abandoned.

In Norway, I understand, the metallic circuit has been substituted for the single-wire system to a large extent. Is that necessary in country districts?—My views are extremely strong that no telephone circuit is perfect or complete until it is made with a metallic circuit.

You would not, even in the country districts of England, advocate a single-wire circuit?—No; certainly not.

Would it represent much difference in the matter of cost?—Very little. I don't think the difference would enter into the matter of cost at all.

Continuing, the Witness said, that in Sweden the subscribers had to provide part of the capital and the charge was included in the first year's subscription. As regarded Germany he had been unable to ascertain what the cost of construction had been, but his own belief was that it was more costly than in England. The whole telephone system in Germany was in the hands of the Government. It was worked on an absolutely uniform system as to tariff apparatus and mode of working. They had constantly thrown at them the fact that why the telephone had developed so wonderfully in Berlin and Stockholm was that the rates were cheap. But in Germany it must be borne in mind, the cheapness of the rates was spread over the whole country, and there were only two towns, Berlin and Hamburg, which could be said to be phenomenally developed in a telephonic sense. Nowhere else in Germany was there any comparison to be drawn in telephonic development with that in some parts of England.

Is it a fact that the charge per message over a trunk wire is the same for all distances?—It is the same. Throughout Germany, as a rule, the charge is one shilling, but the trunk system in Germany, even with that cheapness, is not nearly so much developed as it is in England. We have in England 937 trunk services now at work. In Germany they have only 550 or 580.

Does the shilling include the whole charge?—Yes. You cannot say that the development, judging from my experience in these various countries is really due to cheapness, because, while, on the one hand, in Germany you have a great development in Berlin and Hamburg, you haven't it in the rest of the country: and when you go to Scandinavia you find that in Copenhagen and in Norway the rate is over £8, while in Sweden it is only £4 8s., and yet the development in those countries is almost as great as in Sweden.

Do you know whether in Stockholm the State works the telephone system at a loss?—Yes. There is great competition between the State and the private company. The State works at a very great loss, and so does the company.

Is the rate uniform in Germany?—Yes. Everywhere it is £7 10s., but the Government will not give telephonic communication except on a five years' lease.

Witness, continuing, said that Germany was working the telephone system at a loss, and the late Postmaster-General announced that he was considering a system of charges which would obviate that loss. The German system was a single wire system all over the country, and now they were face to face with the very serious difficulties arising from that. In Berlin they were contemplating converting it into a metallic circuit, which would involve the expenditure of a very large sum of money. In Sweden and Norway there were no wayleaves, no patents, and no rights of any sort whatever, and no tax was paid to the Government. Although in Germany it was a single-wire system, and from a technical point of view a very poor service indeed, it worked really well in Berlin, and the public were quite satisfied with it. This arose from the simple reason that the people in Berlin took a very great interest in their telephone. They had learned all about it; they visited telephone exchanges, and they had certain places where they were allowed to go and see the telephone working. They made themselves thoroughly acquainted with how the switches were worked, and, as a matter of fact, the subscriber, instead of throwing all the work upon the operator, did it himself. In England subscribers were more exacting. They wanted the telephone operator to do everything for them. This involved loss of time, and he was sorry to say at times a little bad language. If one quarter of the intelligence of the operator were transferred to the subscriber, he believed that 99 per cent. of the complaints about the working of the telephone would not arise. Regarding France, the service there was more expensive than in England, it was less developed and there was not much to be learned from that country. The system there was in the hands of the State, and the tariff of rates was a most complicated one. The telephone system in Italy was a very bad one. It consisted almost entirely of purely local exchanges, and it was not possible to telephone through, say, from Rome to Turin. There was a very well developed system in Belgium, but it was badly worked.

The principal point in our reference is how far the telephone is or is calculated to become of general benefit. Do you think it can be made of much more general benefit in England than it is at the present time?—Yes; at the present time there is a vast area of country that may be said to have been wrested from the Telephone Company, and that area is absolutely in an undeveloped condition. We have at different times in the Post Office endeavoured to see if it was not possible to extend the telephone system to those rural districts.

You speak of a vast area wrested from the Telephone Company. Is it not rather that the Telephone Company has wrested from the Post Office?—No.

Well, will you just tell us how far the National Telephone Company is wresting places from the Post Office in which it has entered into competition with the company?—Such places as Newcastle, Cardiff and Newport, Leicester, Hull and Plymouth.

Those are places in which you were first in the field?—Yes, and those are places where we established a very perfect system of telephoning indeed. In Newcastle, in particular, the telephone has

been perfected as a working machine more than anywhere else, even in America, and yet in Plymouth, Leicester, and in Hull our exchanges have broken down. In South Wales we have maintained our position fairly well. It is not a question of rates, because there is not much difference between those of the company and ours. It is simply a question that we have been absolutely restricted from carrying out any of the ordinary methods that a commercial concern adopts to push its business.

How have you been hampered?—Take for example Plymouth. There we went in, not as a speculative concern, but in obedience to the requisition of a number of people. We established on the most approved systems. Having got our exchange to work, we excited the envy, or jealousy, or malice, I don't know which, of the Telephone Company. They came down there, and the first thing they did was to go to every one of our subscribers and offer them telephones for nothing during the continuance of our five years' agreement. They were supported by extremely active and energetic people there, and what with free service and other things our exchange did not increase during our five years' agreement, and at the expiry of that time we lost our subscribers. The fault was not that of the Post Office.

Will you say on whom you lay the blame?—I have no hesitation in saying the development of telephoning in this country has been absolutely checked by the restrictions placed upon the Post Office by the Treasury. In the first place, we could not get authority to carry out any extension unless we could show reasonable prospects of obtaining a profit on the construction. We want to send our men around to compete with the Telephone Company, but we are strictly forbidden by the Treasury to do that, and we were obliged to sit quietly in our offices and allow our business to dwindle away from us without being able to make any attempt to retain it.

Has that system of preferences on the part of the Telephone Company been at all general?—I believe it has existed everywhere.

The company ask that if municipalities are allowed to compete with them, they should not have any advantage over them. They had not dealt in that spirit with the Post Office?—They have been allowed to employ the usual commercial means of securing business, and we have been prevented from adopting the same means, although we were anxious to do so.

The CHAIRMAN: I will ask Mr. Lamb, who is in the room, whether this question of preferences was ever brought before the Treasury when it was asked to remove these restrictions?

Mr. LAMB: I am perfectly sure it was.

Will you hand in a statement to us showing the representations that were made to the Treasury?—Yes.

The CHAIRMAN (to Mr. Preece): As a matter of fact, the service has not been a losing one to the Post Office?—Certainly not; we have paid a very fair interest.

If you had a free hand now with your own post office exchanges, what would you do with a view to making the service of more general benefit than it is?—I desire to place before the Committee the advisability of introducing into England what is known as the toll system, which is in operation in America. The essence of that system is to charge only for the work done. My view is that this toll system in itself is an extremely fair mode of charging, because you really extract from the user of the telephone something *pro rata* for the services you render him. My idea is to base the initial rental on the length of line, which must vary with the character of the city or town. I think that if in London we were to start with an initial subscription of £4, with a penny a message, we should find that we should attract a great number of additional subscribers. The penny would be charged simply for outgoing messages and not for messages received by the subscribers. This system would also have this advantage, that it would throw the telephone open to everyone.

Replying to further questions, the WITNESS said the system of public call-offices had been very little developed in this country. In Stockholm there were 700 call-offices in shops, while in the United States there were 2,500 scattered over the country. The cost of trunk lines so increased with the length, especially in working expenses, that he would maintain differential rates for trunk lines. In a number of areas, for which the National Company had licenses, there were no subscribers and no service. There were two such areas in Anglesey alone. In that island he thought the Post Office should be allowed to make an experiment on these lines. There were four head post offices, including those of Holyhead and Beaumaris, and all over the island were scattered small post offices. Each of these he would make a telephone call office. Then he would have groups of subscribers—three, four, or five—using the one line to the exchange, and so greatly reducing not only the cost of the wire, but also doing away with a complicated exchange. In Anglesey, where many well-to-do farmers and wealthy residents lived, they would probably agree to subscribe to such a system for a charge of £2 a year and a penny a message. Perhaps Bangor could be made the centre of the district, and telegraphic messages could be sent by telephone. That was now being done to a considerable and increasing extent—as it was less expensive, a skilled telegraphist not being required—not only in Wales, but in Scotland and in Ireland. The scheme he had outlined for Anglesey was very successful in America. By adopting this scheme the Post Office might succeed in working up a business, and although it would naturally be an experiment of a speculative character, he did not see that the Post Office should not be allowed to carry it out.

Assuming you had a free hand in Newcastle, where the service is so good, what would you do?—We would do exactly what the National Telephone Company are doing. We would go and see everybody who might want a telephone, and we might reduce the price.

Do you think the telephone would be very remunerative if it were extended to everybody?—It would depend very much on the education and the energy of the people whom you wished to serve.

What have you to say regarding the accusation that has been made that the Post Office has surreptitiously laid down wires and then handed them over to the Telephone Company?—I emphatically deny it. The Post Office has never laid down an inch of wire for the use of the Telphone Company's subscribers, except such as were laid down under the agreement.

By Sir HENRY HOWARTH?—He looked upon the proposed extension of telephones by municipalities as utterly out of the question from a practical point of view.

In answer to Mr. BOSCAWEN, Mr. PREECE said that in his opinion the condition of the telephones in this country was the very best, and it was a most unjust thing to have it appear in the press and other places that the service was far behind the age.

The Committee adjourned.

The Select Committee on Telephones resumed its inquiry on Tuesday last, Mr. Hanbury again presiding.

Mr. PREECE, the chief electrician to the General Post Office, whose cross-examination was not finished at the last sitting, was re-called. He said he wished to correct his statement made last week that the telephone service in Germany was carried on at a loss to the Government. He was not quite right, too, when he said that the charges in Germany were uniform, for he had since ascertained that recently a 2d. trunk rate had been introduced within an area of 30 miles, and there was a 3s. rate for urgent messages.

By Mr. BOSCAWEN: The present population of London was 4,211,743, and the number of telephone instruments in use 25,724. In Berlin the population was 1,578,794, and the number of telephones 36,650.

Would you still say that Germany is far behind England in the matter of telephones?—I did not say that.

WITNESS, continuing, said there was no doubt that in Germany the telephone was more advanced than in England, and the rates were lower, but we were not so backward in this country as many people seemed to imagine. It must be remembered that in Germany they had no night service. The system there was worked by the Post Office, which had a free hand and no restrictions. He condemned the automatic switch because he had been informed that it had failed in Sweden. As a piece of mechanism the automatic switch which had been brought over from America was a beautiful thing, and from a mechanical point of view there was nothing to be said against it. In America the automatic switch system had been on its trial for 20 years, but as he had before said, he was not prepared to accept the evidence which had been given as to the success of the system in that country.

Do you think that there ought to be further telephone extension in this country?—Certainly.

What is your idea of what ought to be done?—My idea is the toll system. Continuing, the WITNESS said that the National Company had never adopted that system, and possibly the point had only been just sprung upon them. The Post Office was in a position, and were anxious to extend the use of the telephone system; all they wanted was a free hand. They would be willing to go anywhere where there was a local demand. He had no doubt that if they got rid of the Treasury restrictions, they could very largely increase the business.

Replying to Mr. COLVILLE, the WITNESS said he wished to say that the telephone area of Berlin was very small, and if a subscriber wished to communicate with the suburbs, they had to pay another £2 10s., so that to cover the whole area the subscription was £10. In Germany there was no royalty to be paid, and no wayleaves. The Post Office rate in London averaged about £9 for a three-mile area.

Do you wish the powers of the Post Office to be greatly extended?—Yes.

You express yourself adverse to the granting of licenses to municipalities?—I am very strongly against the granting of such licenses, as it would only add complications to what is at present a very complicated question. With respect to the evidence that had been given as to the prices at which it was estimated that municipalities could supply the telephone, Mr. Preece said he was not prepared to accept some of the statements on that point without very careful examination. Mere cheapness was not the only question to be considered in the development of the telephone.

In the event of your idea being accepted by Parliament that the Post Office should have greatly increased powers for the development of telephones, should we have lower rates?—I think that once the toll system were introduced in rural districts, that it must follow that the same system applied to the trunk system must also be applied to town systems. However cheaply a municipality could establish a telephone system, the Post Office could establish a cheaper one.

By Mr. BARTLEY: The reason they could supply cheaper than a municipality was because the Post Office already had the powers, the buildings, the administration, and the organisation, and they also possessed a technical staff possessed of the very highest skill.

Replying to Mr. COHEN, the WITNESS said that although it was not fair to draw a comparison between Berlin and London, it was fair to draw a comparison with the uniform rate in the German provinces, and with the rate in provincial towns in England. He advocated an initial charge of £4 together with the payment of 1d. per message. Under the present system the use of the telephone was restricted to the subscriber, but if 1d. was paid for every message, there would be no need for any such restriction. A shopkeeper could have the instrument in his shop, and any of his customers could use it on paying. He did not think that that system would result in a loss because if one tradesman kept an instrument others would feel bound to do the same. His opinion was that the Post Office could make the service a paying one under such conditions. He felt sure that if the public were better acquainted with the Post Office facilities for the use of the telephone, greater use would be made of the service, but as he had said, the one way in which they could bring that knowledge before the public—by means of canvassers—had been prohibited by the Treasury.

Do you think that if the toll system were adopted it would result in large firms paying more than they do now?—I have worked out that question rather carefully, and taking the average number of talks per day per subscriber on the present system, the figures are as follows:—In England 8, in Sweden 7, in Berlin 12, in Copenhagen 12, in Chicago 13 6, but in Buffalo, where the toll system has been in force for nearly 15 years the average is only six. I think this toll system has a deterrent effect upon those who use the telephone system simply to ask silly questions. Continuing, WITNESS said that the first great advantage of the adoption of the toll system was that it would restrict conversation and check telephone abuse. In Switzerland where the system was in use three talks per day worked out at a cost of £6 9s. 2d. per annum, and one talk per day, £4 9s. 2d.

I understood that the restrictions of the Treasury had been removed! What further powers do you advocate for the Post Office?—I think we should have a free hand to develop, say in such a district as Anglesey, without the restriction of being forced to show a profit. It would be very difficult to work on a new thing and show a profit at first.

By Mr. BOSCAWEN: He would not include the giving of preferences in a free hand, but he doubted whether preferences were given by the National Telephone Company to the extent some people imagined.

The CHAIRMAN: You would give no preferences, and you would be liable to supply everybody?—Yes, I think the whole British public ought to have equal rights to receive the telephone service at the same rates.

In that respect, then, the Post Office must differ from the National Telephone Company?—That is so, for, of course, it is the function of the Post Office to serve all applicants.

Mr. COHEN: Do you think that an obligation on the Post Office to serve everybody would handicap the Department unfairly?—It would to this extent, that we should be obliged to serve certain districts at a loss, but we should compensate ourselves by the profit we derived from other areas. If it should be the misfortune of this Committee to recommend the granting of licenses to municipalities, then they would walk off with the cream of the business, and the Post Office would be left with the unprofitable areas. If the Post Office had the whole service he believed it would be worked at a profit. At present their powers in respect to opening the streets were restricted, for they had to obtain consent of the local authorities before they could do it. They desired to have the same powers in that respect as was accorded to every electric lighting enterprise.

Replying to the CHAIRMAN, Mr. PREECE explained the difficulty which the Post Office had recently had with the City Corporation in relation to the opening of the streets, and said it was not a fact that they were using the powers of the Post Office to lay wires for the National Telephone Company, excepting between exchange and exchange.

Mr. NICOL questioned Mr. Preece at some length as to his objections to municipalities being granted telephone licenses, and the WITNESS in reply said that his chief objection was that the telephone was not merely a local business, like sewers, water, gas, or electric lighting, but was absolutely imperial in its character, and covered the whole of the country. The desire of local authorities to work telephones was based on the three following assumptions:—First, that the Post Office could not do the work properly or cheaply; second, that the National Telephone Company did not do their work properly; and the third was that the municipality could do it cheaper and better than either the Post Office or the company. He contended that all those three assumptions were wrong. The Post Office did its work as well and as cheaply as any other body; and as to the National Telephone Company, he thought they were doing their work in those cities where they had been enabled to put metallic circuits underground, as well as it was being done abroad. Another reason he had for granting licenses to municipalities was, that whatever difficulties and anomalies there might be in dealing with a second party, would be intensified if a third party were introduced. In 1911, the Post Office would be in the position of having to buy two systems instead of one, and it would very greatly add to the difficulty of the question of absorption.

From your experience as an electrical engineer, do you think the system would be more difficult to work if the municipal authorities, the National Telephone Company, and the Post Office were all in active competition?—It would add to the difficulties, and to a certain extent the delays in communication between subscriber and subscriber.

In your opinion do you consider that the two systems—the telephone and the telegraph—overlap one another?—No; I think that they assist each other. The use of the telephone is of enormous advantage to business men in transacting their telegraphic business.

If the two systems were in the hands of the State, would not the telegraph revenue be interfered with by the telephone?—Certainly not; the two businesses would form part of the same revenue.

Do you find that the local telephone systems have interfered with the Government revenue from telegraphs?—The only place in which it might be at all likely to interfere with the telegraph would be in London, and by a curious state of affairs the introduction of the telephone into London has rather improved our telegraphic business, I think I ought to mention that perhaps one reason why the telephone has not increased so largely in London, as compared with other places, is that the local telegraph service in London is magnificently organised. Mr. Preece then gave some interesting figures which he had prepared relative to the cost of telephoning the Island of Anglesey. He explained that he had divided the isle into certain areas, in order to obtain his estimate, which could therefore be considered reliable, and taking the whole of Anglesey, the conversion of the telegraph circuits that were there now into telephone circuits would require a capital expenditure of £1,800. If to that they added about £3,000 for other expenditure, they would be able, for a sum of about £5,000, to make a crucial experiment, and determine the practicability of the scheme. He regarded that scheme as an ideal one.

The CHAIRMAN: Assuming that you got permission to start this scheme in Anglesey, would not the National Telephone Company have the right, under its agreement, to at once come in competition with you there?—They would. If it were the desire of the Treasury that such an experiment should be carried out, I would rather take a district where we are well established already, such as Newcastle, and I would like to go into strong competition with the National Company on their own ground in places where they have hitherto beaten us.

You make this suggestion for working a new place like Anglesey with a full knowledge of the fact that, wherever you started, the National Telephone Company, under its agreement, would have the right to come down and attack you?—Certainly.

You are not afraid of competition between two rival exchanges in the same area?—Not a bit.

By Sir JAMES WOODHOUSE: There were only a limited number of persons competent to work the telephonic system of this country, and the Post Office and the National Telephone Company practically had all the telephonic staff in the country. Therefore it would be a very difficult matter for municipalities to establish a system of their own. They would either have to train their own servants, which would take a great deal of time, or else they would have to offer higher wages to the Telephone Company's servants, or to the Post Office, than those they now received. He would not deny that a municipality might be able to work the telephones cheaper than a private company, but they could not do it cheaper than the Post Office.

Replying to Mr. CAWLEY, Mr. PREECE said that most of the instruments and material used in telephoning were made abroad. He believed that strikes and trade unions had driven the trade out of this country. There were factories in Coventry, Manchester, and Cheshire where certain materials were manufactured, but there was no manufactory in this country that made the important part of the telephonic system, such as the switching contrivances, the jacks, and the plugs, &c. In the early days of the industry these articles were made in this country on a small scale. He could not agree that the industry would be greatly developed if the telephones were in the hands of several bodies rather than confined to the Post Office and the National Company. He believed that the system was likely to grow enormously in private houses as well as in hotels.

By Mr. BARTLEY: He was decidedly of opinion that the time had come when the Government should take the matter of the telephone monopoly in hand and arrive at some solution of the difficulty. The matter was surrounded with difficulties, which would inevitably increase as time went on. That was undoubtedly due to the great mistake which was made in giving the original license to the National Telephone Company.

The CHAIRMAN: Assuming that you had a free hand, and wanted to start all over the country an alternative plant on the part of the Post Office to that of the National Telephone Company, how long, speaking roughly, would it take you to construct it?—Do you wish me to consider their system as it is now, or their system as it will be in 1911?

Their system now?—Just as a rough shot. I should say it would take us to establish in this country a system such as the system of the National Telephone Company, serving 106,000 subscribers, about five years. If the work was delayed until 1903 and the National Company kept on increasing at their present ratio he should say it would probably take them about six years, while if things went on until 1911 it would take them about seven or eight years to establish a similar system to that which the National Company would then have in force.

The Committee then adjourned.

TRAIN RESISTANCES.

A WRITER to the *Engineer*, recently discussing the question of train resistances, assumes that a mean of the allowances of Pambour, Rankine, and Clark, will give a fairly accurate figure. Possibly no subject connected with railways has been more discussed than this one of train resistance. For many years it was the custom to draw limiting lines for railway speeds on the supposition that as resistance increased as the square of the velocity a limit would be reached early at which the resistance was greater than the engine pull. This supposition has been quite falsified, but no very accurate theory has been put in its place. When the question of train resistance was first debated, formulæ were got out from results obtained with iron rails badly jointed and with poorly ballasted track. All these matters are now changed, and it is time something more definite were known as to resistance under modern conditions. The resistances against a running train are several. Practically confined to the locomotive are the head resistance due to the air, not a

very large matter, and the consolidation of the track, and the internal friction of the locomotive. These, deducted from the gross power, should leave a remainder which ought to balance with the draw bar pull.

The train resistance is composed of side friction of air, of axle friction, and of the resistance due to that continual running up hill due to every wheel being in more or less of a depression, out of which the recovering rail would help it if the track were perfectly elastic. Undoubtedly, the most serious item of all is the axle friction, and should some of the roller bearings we have seen, prove durable, it is certain that train resistance would be very substantially reduced, and an immense economy secured by their use. The *Engineer* asserts that the drawbar pull is always less at high speeds than at low speeds, and that the area of the indicator cards is also less. But the power developed depends upon the number of cards made in a given time, and at high speeds, of course, this is larger. The total power developed per minute is greater. From this has arisen the false assumption that the pull is greater—an entirely unwarrantable conclusion. The pull may readily be less at high speeds. In the first place, the axle box friction may be reduced. Our contemporary holds journal friction to be at least constant at all speeds. There are good reasons to suppose the rail resistance will decrease with high speeds, especially with closely supported rails and heavy rails of stiff steel.

Possibly the air resistance alone is a growing factor with speed. We hear a great deal about superior rolling stock in America, but from the same source we get news from time to time of locomotives showing an indicated horse-power for a given speed and load very much greater than such a speed and load would demand here. American figures cannot be compared with English figures, and no one seems able to state whether the difference is in the track, the vehicles, or the locomotives. All three items are claimed by Americans to be superior to the same in England, yet one must be very inferior. There is, of course, no fundamental reason why a high speed when once attained should demand a larger pull. An ounce pulling a body as massy as the Sun itself would, in time, attain an infinite velocity, and it seems to us that the difficulty with the locomotive is that if it could manufacture bigger indicator cards at high speeds it would run a train at higher speeds than at present are possible, which, if true, would point to possible greater speeds with larger wheels and larger boilers to supply the steam to more cylinder volume. The *Engineer* suggests that some accurate knowledge of the relation of I.H.P., speed and resistance, should be obtained by taking diagrams day by day over some particular stretch of road in all weathers so as to settle the train resistance problem. We think it would be much better to run a dynagraph car behind the tender fitted with all necessary appliances, marking off the quarter mile posts as they pass, and noting if possible the speed by some speed indicator.

The engine power might be approximated by means of a continuous power meter of the Ashton type, with suitable arrangement for marking the distance posts on the paper. On a good road a train ought to run much more steadily at high than at low speeds, because of the stiffening effects of velocity upon moving bodies as shown in the gyroscope.

Such a series of experiments as suggested might be of great use. Something of the kind has been done in America with the Dudley car, and we believe that the drawbar pull in American practice has been found remarkably less than the I.H.P., as though there were a very considerable absorption of power in the locomotive and tender. A knowledge of tractive effort is wanted by electrical engineers for, possibly, the immediate future. At the same time, were electric traction established, the ease of making power measurements would very greatly assist to sound and accurate conclusions.

The locomotive presents considerable difficulties in indicator work, and such work as has been done is not always published. On the Midland Railway Mr. Johnson had one of the large singles fitted with a glass house for the indicator operator, and we believe a lot of work was done, but we have seen nothing of the results. In regard to electrical traction, the Liverpool and the South London line should be able to furnish good information on train resistances up to the moderate speeds they employ. But it is rather the high speed figures of which information is lacking.

The formula proposed by Mr. Leahy in his letter to the *Engineer* is

$$R = 1\tfrac{1}{4}\left(v^2 \cdot 005\,\frac{A}{W} + 6 \pm 2{,}240\,i\right),$$

where R is the gross resistance in pounds per ton, V is the velocity in miles per hour, A the cross sectional area of the train in feet, W the gross load in ton, and i is the inclination fraction of the line. Where $\frac{A}{W}$ is equal to unity the atmospheric resistance becomes simply $v^2 \cdot 005$, and W is then the critical weight of the train. Thus A may be easily 120 square feet. For such a cross-section the critical value of W is 120 tons. The formula seems a reasonable one, but we are inclined to think that though the fraction $\frac{A}{W}$ may have a rational derivation it might be almost better to introduce the element of train length. Possibly, however, for general practice W and L have a fairly steady relative value. The 6 in the formula is a constant for friction.

NEW PATENTS.—1898.

Compiled expressly for this journal by **W. P. Thompson & Co.**, *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*

14,204. "Improvements in electric batteries." M. M. Bair. Dated June 27th.

14,211. "Improvements in or relating to excitant solutions for electric batteries or the like." A. J. Ward. Dated June 27th.

14,212. "Telephone transmitter." F. A. Ray. Dated June 27th.

14,213. "Improvements in dynamo-electric machinery." W. Langdon-Davies. Dated June 27th.

14,217. "Improvements in electric miners' lamps." W. O. Wood. Dated June 27th.

14,237. "An improved electrical safety fuse and cut-out." C. J. Cooper. Dated June 28th.

14,245. "An improved method of generating electricity or other forces by the agency of compressed air and vacuum, such compressed air and vacuum to be obtained by utilising the rise and fall of tide or river flow." F. C. Southard. Dated June 28th.

14,255. "Improvements in electric telephony." C. Adams-Randall. Dated June 28th.

14,293. "Improvements in systems of electrical distribution." R. Belfield. (C. F. Scott and B. G. Lamme, United States.) Dated June 28th.

14,306. "Improvements in movable zero relays." E. A. F. Arnaud and C. A. A. G. Gantes. Dated June 28th. (*Complete.*)

14,316. "Improvements in and relating to dry and other galvanic batteries." A. E. J. Ball. Dated June 29th.

14,318. "Improvements in dynamo-electric machines and motors." S. G. Brown. Dated June 29th.

14,331. "Improved diffuser and economiser of electric light." S. T. White. Dated June 29th.

14,363. "Improvements in electric switches." C. P. Elieson and W. S. Naylor. Dated June 29th.

14,380. "Improvements in electric batteries." E. Giglio. Dated June 29th.

14,399. "Improvements in or connected with electric measuring instruments." A. B. Blackburn and W. L. Spence. Dated June 29th.

14,427. "A new or improved filament for electric incandescent lamps and process of manufacturing the same." English Industrials, Limited, and G. E. Heyl-Dia. Dated June 30th.

14,433. "Improvements in electric bells and bell fittings." B. A. Phillipson. Dated June 30th.

14,455. "Improvements in secondary batteries." T. A. B. Carver. Dated June 30th.

14,513. "A method of and apparatus for producing electrical spectacular effects." C. H. Cox. Dated July 1st.

14,548. "Improvements in electrical contact makers." E. W. Bowles. Dated July 1st.

14,566. "Improvements in electrical resistance devices." H. H. Lake. (Stralsunder Bogen-Lampenfabrik, Gesellschaft mit Beschrankter Haftung, Germany.) Dated July 1st.

14,614. "Electricity meter for alternating current motors." F. Laarmann and H. Brockelt. Dated July 2nd. (*Complete.*)